How Geek Kids Get Geek Jobs: a Cross-Generational Inquiry into Digital Play and Young Adults' Careers in IT

by

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Thesis Abstract

From programming ‘home-brew’ games, to modifying the content of existing commercial titles, digital gaming can be regarded as a potential gateway into more serious uses of computers; welcoming some while repelling others. The socio-demographic makeup of computer science, games development and related areas of work are of interest to feminist scholars of culture. In light of skills shortages, industry is also interested in increasing women and ethnic minorities’ participation in STEM fields. Representational inequalities within tech are regarded as a social issue not just because this area of employment can be highly lucrative, but also because control over tech can provide other forms of empowerment - including being able to influence and shape everyday communication technologies. However, the route into these industries has historically been shaped by a number of factors including formal computing education, the rise of hobbyist computing and a surrounding masculine 'geek' culture - and a sort of reciprocal relationship between hobbyist computing and digital games.

This thesis interrogates the idea of games as a form of ‘technological enculturation’; the notion of a causal link between gaming and careers in computing. I take the biographies of those working in the IT sector in southeast England and explore the role of gaming in the personal histories of what appears to be a predominantly white and male group. The thesis pays great attention to salient differences between technological platforms – something relatively underdeveloped in the existing literature on player cultures and in game studies more generally. Finally, I take a cross-generational perspective by comparing the experiences of adult IT workers with a cohort of teenage ICT students. Using a theoretical framework adapted from leisure studies and the sociology of Pierre Bourdieu, I explore how certain types of game-related activity – but not all gaming – are particularly conducive to producing young people who are a good ‘cultural fit’ for this particular set of professions. This has implications for how we think and talk about increasing participation in STEM, as well as the somewhat under-developed role of games and game-making in UK schools.

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I would also like to thank my wife, Jade, for her unerring support through an often bewildering period of learning and growth, as well as my two young children - Dylan and Emilia - who have helped me to remain grounded and focussed.

Confidentiality Notice

All human participants who have contributed to this research project have been given pseudonyms to protect their identities, and a number of them have also been consulted prior to preliminary data analysis, in order to triangulate the interpretations I was making of their accounts. The thesis also makes no ad verbatim use of text which would make participants traceable through web searches.

Structure and Context

This thesis represents an interdisciplinary investigation into an issue which has been of interest to researchers of computer and videogame players since at least the mid 1990s. It has been argued that games played on either personal computers or dedicated games consoles play a key role in young people's technological learning. This theory of digital games as 'technological enculturation' has been applied by scholars of gaming culture who posit that the perceived masculinity of digital games has broader effects on the makeup of technology-related professions such as computer programming in relation to gender (Beavis & Charles, 2007; Cassell, 2002; Barron, 2004; Carr, 2005; Cassell & Jenkins, 1998; de Castell & Jenson, 2004; Natale, 2002; Hayes, 2008) as well as 'race' and socioeconomic status (Andrews, 2008; DiSalvo & Bruckman, 2010). This ties in to broader discussions about the role of 'geek' or 'nerd' identities as cultural barriers to participation in IT work (Bucholtz, 2001; Bury, 2011; Margolis & Fisher, 2003) as well as older conversations about relations between leisure and work (Willis, 1977) and about the factors impacting upon women's participation in leisure activities (Winn & Heeter, 2009; Henderson & Dialeschki, 1991; Henderson & Allen, 1991; Harrington, et al., 1992; Miller & Brown, 2005; Burke, 2004). Overall, this body of work argues that mainstream videogames have traditionally been made and played predominantly by young men, and that this phenomena is a crucial factor in understanding and potentially changing the makeup of the computing workforce. However, I also argue that research in this area tends to treat this relationship between gameplay and hobbyist computing as a sort of a priori assumption, and that more work could be done to provide a strong empirical basis for such claims.

The overall aim of the thesis is to synthesise these various threads and consider them in relation to the biographical accounts of a group of IT workers and ICT students, to better understand the role that gaming has played in shaping their educational and professional trajectories. The adult professionals and teenaged students were predominantly white, male and British, and many of them came from similar social class backgrounds. The adults (n = 21[1]) came primarily from middle-class households which had computer access during the 1990s, while the students (n = 20) were perhaps slightly more diverse in their social origins. The overwhelming maleness of these two groups made them ideal for interrogating some of the existing literature on computing and gender, while also allowing for a more nuanced discussion of consistencies and variations. The remainder of this introductory section will lay out the structure of the thesis; to rationalise the order in which the information is presented and begin to make connections between the existing theorization on the subject matter and the new empirical contributions made by this research project.

The first chapter reviews the literature in order to outline and contextualise the project at hand. Existing theories about the relationship between digital gaming and computer literacy are discussed and evaluated, and some empirical and theoretical gaps are identified. Several researchers in this area indicate that, because videogames have become such a widely enjoyed pastime, and in light of low enrolment in computing and related fields regardless of gender, a special relationship between the videogame medium as a whole and computer science no longer exists, and researchers should instead focus on more nuanced distinctions between types of play

[1] 2 teachers were also interviewed, but only in relation to data analysis regarding their classes. Ergo they are not included here in the figures for adult interviewees.

practices and the demographics engaging in them. This perspective strongly informs the direction of the thesis in general, but has some problems in terms of a lack of empirical support, as well as a tendency to focus on one aspect of social identity at a time.

The second half of the literature review chapter establishes the conceptual framework which will guide the remainder of the thesis. This draws upon; leisure studies to delineate different types of engagement with leisure activities such as gaming, which are experienced as 'serious' or 'casual' by different participants; platform studies to better explain variations in the types of technical learning available to players of different machines; and a Bourdieusian sociological framework which accounts for the role of the family and the domestic transmission of culturally-valued types of knowledge. The aim is to identify an idealised type of computer worker - the 'techie' - and to account for the intersections of gender, leisure, education and work in the formation of such an identity.

The second chapter outlines the research methodology in three stages. Firstly, my own stake and interest in the research topic is outlined, identifying how my own background may have shaped the analyses offered in later chapters. The second section of the chapter deals with the practicalities of sampling and the conducting of the interviews themselves; the 'who, what, why, where, and how' of the interview process itself. The chapter closes with a broader discussion of biographical research in sociology, its history and its processes for maintaining a kind of validity despite being so heavily dependent upon participants' subjective recollections as a form of data. Having laid out the existing research on the topic, and the methodologies in play, the data analysis segment of the thesis follows a three-part format.

The first data analysis chapter - Chapter 3 - deals with the changing role of games in the leisure-work biographies of the adult participants, as well as material changes to the technology since the 1980s which may have mediated the types of learning experiences available to different generations of hobbyists. Here it is necessary to lay out which technologies have been available at different points and time and to whom. In doing so I discuss the technologies themselves in relation to educational policy, public discourse and the accounts of the participants themselves.

Chapter 4 focuses more on the professional roles held by the adult interviewees, seeking to identify how the early gaming activities discussed in Chapter 3 provide these individuals with a type of 'cultural fit' into their present workplaces. Here I discuss experiences and attitudes which were typical of the group, including the role of parents in their initial interest in computing, as well as the ways in which the informality of their hobbyist learning transfers over into a professional field where constant self-tutorage is often regarded as an industrial norm.

Chapter 5 introduces a new set of interviews to discuss whether and how the patterns of socialization discussed in earlier chapter transfer to younger participants - namely young male gamers studying ICT between the ages of 16-19. I analyse the accounts of the teenaged respondents and identify several typical ways in which young people may relate to both games and computing as an object of study. This chapter illustrates a diversity of gaming and computing experiences, affected by peer-group norms and also by family influence and income.

By analysing the data in this loosely chronological order, I am able to identify existing patterns in the biographies of the older participants and then to discuss the extent to which these patterns continue to hold in the younger group. Following these three chapters of data analysis, the closing section will briefly summarize the overall findings and restate the original

contribution of the thesis, while offering some recommendations from several different perspectives, as well as important caveats regarding the overall analysis.

Chapter 1: A Theory of Digital Gameplay as Technological Enculturation

1.1 Outlining the Issues

1.1.1 Digital Games as 'Technological Enculturation'

Much of the existing literature on gaming and gender has foregrounded a perceived connection between this leisure activity and well-paying careers in the IT sector. Although earlier investigations into computing and gender had indicated some connection to videogame culture (Turkle, 2005; Wajcman, 1991; Haddon, 1990) this position was crystallised most clearly in From Barbie to Mortal Kombat: Gender and Computer Games; a 1998 collection edited by Justine Cassell and Henry Jenkins. The editors summarize the thinking behind the book as follows:

> The relationship between boys' comparatively higher interest in computer games and their comparatively larger representation in high-power computer jobs is not accidental. Computer and video games provide an easy lead-in to computer literacy… and so those children who aren't playing them at young ages may end up disadvantaged in later years. (Cassell & Jenkins, 1998, p. 11)

The perspective suggests that the social dynamics of gaming culture matter, not just for the sake of diversity and representation within gaming itself, but because of its preparatory role in relation to computing education and employment. The under-representation of girls and women in IT courses and professions, it is argued, has partially stemmed from the way that many girls have come to view gaming as an "alien culture" (ibid. p.13). I describe this body of research as holding a view of games as technological enculturation; i.e. one in which games are viewed as tools for the acquisition of attitudes and abilities associated with IT careers. Although the meaning of these terms vary between theorists, I use 'enculturation' rather than 'socialization' to indicate the process of being brought into a particular culture – such as that of the computing professions. Although the Oxford Dictionary of Sociology (Scott & Marshall, 2015, p. np) describes enculturation as "virtually synonymous with socialization", its use here also helps to avoid an confusion between the sociological concept of childhood 'socialization' and the more everyday usage of 'socializing'. The 'technological enculturation thesis' is a term I use to describe a body of work which positions digital games and/or the surrounding culture as causal factors in the demographic makeup of computing-related study and work, and is summarized in greater detail in 1.1.4

Justine Cassell (2002) suggests that the arrival of videogames is a key moment in the "genderizing" of human-computer interactions. In Anglophone countries during the early-mid

20th Century, computing had been regarded as a secretarial, clerical type of work, with women from Mathematics backgrounds being prominent early programmers (Lumbar, 1998, p. 25). In the United States, female enrolment in Computer Science degrees dropped off in the mid 1980s, with no similar decline in Medicine, Law, or Physical Sciences enrolment (Henn, 2014). It can be argued that computing, which started out with "an ambiguous gender identity" (Ensmenger, 2010, p. 136) underwent a period of masculinisation during the 1980s, with boys coming to dominate informal learning spaces such as school computer clubs, while becoming the assumed target market for games and hobbyist magazines (Haddon, 1990; Wajcman, 1991; Lumbar, 1998). Games became part of a male-dominated "learning ecology" (Barron, 2004) and magazines for gamers continue to address an assumed male audience almost three decades after their introduction (Fisher, 2012).

From this perspective, games have played a historical role in the ongoing gendering of the STEM subjects (Science, Technology, Engineering and Mathematics). Judy Wajcman argues (1991, p. 146) that there is nothing inherently 'masculine' about technological hobbies or careers – rather the definition of masculinity shifts between physical power and intellectual rationality to suit men's attempts to retain socio-economic power; always constructing women as "ill-suited to technological pursuits". The arbitrariness of the association between masculinity and technology is illustrated by the cases of countries where computer science continues to be regarded as 'women's work', as in modern Malaysia (Mellström, 2009). There is, however, a noticeable lack of empirical research into how young players actually acquire computing skills through or alongside their gaming. In one chapter of Beyond Barbie and Mortal Kombat: New Perspectives on Gender and Gaming, the 2008 follow-up to Cassell and Jenkins' earlier book, educator and literacy expert Elisabeth Hayes identifies the lack of work in this area:

> We have little specific or systematic documentation of individual players' trajectories of learning and development of expertise – which games are more likely to trigger such learning, which players engage in such practices, or what conditions seem to be important in supporting this trajectory of expertise. (Hayes, 2008, p. 222)

The relationship between digital play, computing and social identity is often presented as an a priori proposition to rationalise research into the gaming habits of those underrepresented in computer-based fields of education and work. For example, De Castell and Jenson (2004, p. 385) have argued that the gendering of videogames contributes to the "underrepresentation of women in computer – and technology – focused subjects and fields" and Kerr (2006) has similarly suggested that unequal engagement with games might potentially deny women access to a means of acquiring increasingly valuable technical literacies. Justine Cassell (2002, p. 406) suggests that "computer and video games bootstrap computer literacy" with a supporting citation from Patricia Greenfield (1996) whose research was concerned primarily with the modes of semiotic representation inherent to digital games. Greenfield supports the idea that gameplay may bolster young people's ability to 'read' interactive, computer-mediated texts, but fails to support the conclusion that gaming is directly generative of the forms of computer literacy associated with computing jobs such as programming or the assembly and maintenance of machines. A careful delineation of the different types of computer literacy and how these might be fostered by different types of interactions with games is required will be one focus of this thesis.

1.1.2 Gender Dynamics of Young Peoples' Digital Play Cultures

One underlying tenet of the technological enculturation thesis is that boys and men must either play more games, or interact with games differently. In response to the lack of supporting evidence for the technological enculturation thesis, Hayes (2008) administered a survey about gaming and related activities to 1400 school students in an affluent American suburb. The findings suggested that, although both genders did engage with gaming, girls tended to play games which did not have the same "affordances for technology-related learning" as those usually played by boys, and did not engage in gaming communities in the same ways (p224). Boys were more likely to extend their gaming experience using potentially educational activities such as modding; creating or editing content for existing commercial games (Seif El-Nasr & Smith, 2006; Beavis & Charles, 2007; Hayes, 2008). Hayes reviewed the genres of game most popular among girls and women, noting that puzzle games are not complex enough to encourage fan activities such as modding, whereas games like The Sims might provide a more conventionally girl-friendly arena for girls to engage with practices such as content creation.

Digital games have undergone a period of cultural mainstreaming during the last two decades. This is partially due to the arrival of accessible gaming technologies such as the motion-controlled Nintendo Wii and intuitive touch-screen smartphones (Juul, 2012). Research from the Internet Advertising Bureau (IAB, 2014) suggests that female players now make up a 52% majority of those who had played any type of digital game in the previous 6 months - an increase from 49% in 2011 – but also found that trivia/word/puzzle games were the most popular genre among women. Winn and Heater (2009) also support this finding. These newly-popular 'casual' game genres have tended to be treated with an outright and often sexist contempt by some players engaged with male-oriented 'hardcore' gaming (Vanderhoef, 2013; Kubik, 2012; Boyer, 2009; Salter & Blodgett, 2012). Kubik (2012, p.136) argues that casual and hardcore are relational terms which define each-other, the end result being a perspective within the residual gaming culture of a "normative value to the masculine hardcore gamer, and the devaluation for the feminine casual gamer".

Another source (Llamas, 2014) refutes the stereotypical association between femininity and casual gaming, showing that 54% of players or RPGs (Role Playing Games) which are typically considered a hardcore genre of game, as well as just over 50% of PC gamers. However, given the pedagogical focus of the issue being examined here, it is critical not to conflate girls and adult women. Researchers investigating girls' play habits have suggested that what some may interpret as inherently 'feminine' gaming tastes are actually just those of inexperienced players who happened to be girls (Carr, 2005; Jenson & de Castell, 2010) and that many girls' lack of enthusiastic engagement with hardcore genres may depend more upon a lack of support from peers and family than upon the content of games themselves.

Researchers of leisure have suggested that girls and women are much more likely to have their leisure opportunities curtailed by the expectation of care for others, and to feel guilty for participating in forms of leisure which seem frivolous or self-indulgent (Henderson & Dialeschki, 1991; Burke, 2004). While smartphone games provide a way to fill gaps of time on a device purchased primarily for communication, the Nintendo Wii was advertised to women along the lines of therapeutic 'self-help' rather than pure entertainment (Chess, 2011). Shira Chess' reading of the Nintendo Wii marketing echoes Haddon's observation that, during the

1980s, that female engagement with computers was less playful than boys', and often had to be "justified in terms additional to any pleasure which the activity might provide" (1990, p. 13). It is these casual games which Hayes describes as lacking "affordances for technology-related learning" (Hayes, 2008, p. 224). Subsection 2.1.4 will review existing empirical studies which may contribute directly to an improved understanding of digital games' role in technological enculturation, following a discussion of the current debate surrounding women's participation in technology-related fields.

1.1.3 The 'Girls and STEM' Debate

Educational statistics evidence a gender disparity within the field of computing, which is echoed in university entrance figures, with female students making up just one fifth of applicants to UK degrees in Computing for the same period (Cellan-Jones, 2011). Women's participation in the UK games industry is increasing steadily, but still remains low, partly due to lack of participation in related educational fields. Women made up 6.6% of game industry employees in 2009, which rose to 9% in 2012 (Statista, 2015). Another source (Stuart, 2011) put the figure at 12% in 2011, but also suggested that women were more likely to be employed in non-technical roles. In 2013, women made up only 12% of applications to Computer Science degrees and around 16% of people employed as IT specialists (e-Skills UK, 2014). Strongly gendered patterns have been observed in the uptake of computer-based subject areas in the UK's education system further down. 2008/09 entrance figures for A-Level ICT courses saw roughly a 2:1 ratio of male/female students, while Computer Studies saw boys dominating the subject by around 5:1 (Department for Education, 2011). In 2011/12, the male/female ratio for ICT A-Levels equalised slightly, moving closer to three boys for every two girls - with female ICT students averaging 10% better in terms of achievement - while female students in the Computer Studies fell even further, leaving a gender ratio of less than one girl for every ten boys in Computer Studies or Computer Science (Department for Education, 2013). Although there are debates over subject names - summarised in Irons et al. (2009, p. 83) - I use 'Computer Science', 'Computing' and similar terms interchangeably throughout the thesis, although I draw a distinction between these and Information Communications Technology – or ICT. The difference is discussed later in 1.1.5.

Research has also begun to explore the issue of attrition - why women and ethnic minorities leave the IT workforce (Tapia & Kvasny, 2004). For example, one survey of the performance reviews of 248 tech workers found that female employees tend to receive less constructive and more personal review feedback (Snyder, 2014). Fouad and Singh (2011) surveyed 5,300 women in America with engineering degrees, finding that only 62% had stayed in engineering, mainly due to an "old-boys club" culture in some workplaces. Career attrition is beyond the purview of this thesis as it is concerned primarily with understanding why some young people gravitate toward technology careers.

The concern about low female interest in ICT subjects - upon which the techno-socialization theory of games hinges – echoes broader debates about gender and the STEM curriculum. The theory of childhood enculturation associated with gender feminism[2] sees

[2] "Gender feminism" describes forms of feminism which conceptualise gender as a culturally-specific 'performance', as in the work of Judith Butler (2002). This is contrasted with "equity feminism" (Sommers, 1994) which is

human nature as more of a blank slate, with play as a key site where individuals are first exposed to ideas about the gender-appropriateness of different activities (Francis, 2010, p. 334). Rhiannon Bury's (2011) study of female IT workers in the US illustrates this connection between youthful play and adult work; finding that female participation in typically "masculine" fields was often related to childhood "tomboyism" – a masculine or possibly gender-ambivalent relationship to play (pp. 39-42). The gendering of traits associated with science and technology is, from this perspective, located in the toys that each gender are given to play with at an early age. Low female uptake of STEM subjects in the UK has been attributed to the perceived "masculinity" of essential traits such as experimentation, as well as factors such as parental influence and lack of female role models in relevant fields (British Council, 2011; Wynarczyk & Hale, 2009). The logic of this argument is central to the theory of gaming as technological enculturation, because it suggests that adults are most likely to gravitate toward careers reminiscent of activities which were marked out as appropriate and enjoyable through early play.

Margolis and Fisher (2003) draw on the work of psychologists Dweck (1986) and Leggett (1985) to suggest that girls' relationships with computers may also be negatively affected by an "entity" view of intelligence, where ability is viewed as a "fixed, static trait … and therefore [they] exhibit a tendency toward low expectations, challenge avoidance, and debilitation under failure" (Margolis & Fisher, p. 102). For Margolis and Fisher, girls appear more likely to see success as the result of hard work rather than ability; leading them to become disheartened by failure following hard work, even when that failure can be attributed to lack of experience rather than an intrinsic lack of talent. In short, this view holds that those with typically 'feminine' psychologies avoid challenge because they see failure as a reflection of an immutable lack of ability, rather than an indication that one might succeed with more practice.

Computer science is also a field which has seen frequent association with individuals seeking refuge from human relationships (Mellström, 1995; Håpnes & Rasmussen, 1991; Edwards, 1996) a trend which in turn has led to negative views of young computer experts as solitary and obsessive geeks (Varma, 2007; Margolis & Fisher, 2003). In The Second Self: Computers and the Human Spirit, originally published in 1984, MIT psychologist and sociologist Sherry Turkle suggested videogames provided a "window onto a new kind of intimacy with machines that is characteristic of the nascent computer culture." (2005, p. 67). Turkle suggests that games and programming present the "perfect mirror" of human ability (p. 87) in the sense that they only respond as directed by their users. For Turkle, this is a shared characteristic of videogames and programming, which attracts some people while repelling others. Drawing upon the work of feminist psychoanalysts (Chodorow, 1978; Gilligan, 1982; Keller, 1983; Keller, 1985) Turkle explains male desire toward computers in the following terms:

> Women are raised by women. Unlike men, they do not need to undergo a radical break to define their sexual identity. Unlike men, they are allowed, even encouraged to maintain a close relationship with the woman, the mother with whom they had an early experience of the closest bonding ... The boy's experience of early separation and loss is traumatic. It leads to a strong desire to control his environment ... Men see a hierarchy

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concerned more with equality of opportunity across genders, while being more compatible with evolutionary biology's essentialist perspective on gendered brain differences (Kuhle, 2011) of which gender feminism is more critical.

> of autonomous positions. Women see a web of interconnections between people. (Turkle, 2005, pp. 50-51)

While this may appear to evoke stereotypical notions of women as social and nurturing and men as agentic and competitive, Turkle's research went some way toward challenging sexist assumptions that women's lower rates of engagement were due to some lack or inability. Rather, according to Turkle, women actively decide to disengage from computers due to the social isolation associated with the activity itself. In relation to gaming, Jenson and de Castell (2010, p. 54) similarly argue that girls and women often resist participation in activities which are viewed as masculine, because such participation "threatens their identities as feminine". Walkerine's (2007) work on children, gender and games also suggests that girls face additional barriers in relation to traditional competitively-focussed videogames which are at odds with the co-operative, compassionate normatively feminine identity they are expected to perform in most social situations. However, Judy Wajcman argues that the psychological approach runs the risk of essentialising traits as biologically innate:

> Turkle's predominantly psychological rather than sociological framework leads her to neglect the historical and cultural context in which computing education takes place ... We should be extremely wary of saying that because women have different ways of proceeding, this indicates a fundamental difference in capacity. Rather, such discrepancies in cognitive style as can be observed are the consequence of major sexual inequalities in power. (Wajcman, 1991, pp. 157-158)

Sociological inquiry into women's contemporary relationship to technology hinges around understanding the factors which may have built and strengthened associations between masculinity and technologies such as computers and games consoles. These can include domestic access, the support – or lack thereof – of peers and parents, and the way technologies are differentially accessed and promoted within the school – all examples of "major sexual inequalities in power", as Wajcman puts it. In contrast, psychological perspectives foreground how computer science and certain types of digital gaming present challenges to traditional notions of femininity, which represents a barrier for many girls and women wishing to engage with them. Wajcman's criticism of Turkle's approach in some way mirrors the observation put forth in Carr's ethnographic work at a girls' gaming club (2005), namely that "female nonplayers relate to games in a particular way- because of their unfamiliarity with the medium not because they are female" (p. 478). While the psychological stance may lend itself more to an essentialist understanding of gender, the work of scholars like Turkle and Walkerdine does not necessitate a commitment to biologically-determinist conceptions of gendered psychologies. Sociological and psychological perspectives on technology and gender should not be regarded as logically or ideologically incompatible; more as providing potentially complementary perspectives on similar phenomena.

The case of Harvey Mudd College in California provides a practical example of how women's participation in computer science may be increased (Alvarado, et al., 2012; Klawe, 2013). Writing for business website Quartz (qz.com, 2014) tech journalist Manoush Zomorodi summarizes the factors that went into raising female participation in computer science from 10% to 40% at Harvey Mudd. These tactics included; selective renaming of course materials, contextualizing previously abstract problems into real-life examples – eg. developing software

or games for a specific demographic - and an increased visibility of female role models. Most pertinent to this thesis; classes were divided into those who were genuinely new to the subject – and the often male self-taught hobbyists who tended to want to showboat about their skills in "macho" ways which might discourage newcomers. As will be discussed further in sections 1.2.1-1.2.2, this latter group of predominantly male hobbyists can often come to dominate computer science and other technology-related disciplines when no intervention is made, and members of this group are the focus of most of the data analysis in later chapters.

The current debate is also fraught with questions of motivation. While some initiatives may seek to empower women socially and economically by helping them into well-paying technical jobs, the emphasis at the level of government and business is upon harnessing the untapped potential of the female population to bolster industries deemed economically important. One UK report frames the issue around "women's contribution to future economic growth" (Women's Business Council, 2013) while another quotes American engineer and professor Bill Destler as saying that "diversity isn't an altruistic aspiration; it's a competitive demand" (STEM Business Group, 2013). Meanwhile in schools, girls frequently outperform boys in narrative tasks (Beard & Burrell, 2010; Daly, 2003). In one exploratory study of classroom game-making, Judy Robertson (2012) found that girls tended to outperform boys in producing the narrative aspects of games. Women make up around 73% of enrolment in linguistics and classics and 72% of languages and literature (Women's Business Council, 2013, p. 11). In 2004/05, over half of female university students were concentrating in medicine, education, business and social studies. Males were spread out more but 45% studied business, engineering, computer science and social studies (Self & Zealey, 2007).

The present situation - where lack of female participation in the STEM fields is treated as an important social problem - perhaps reveals as much about the relative social, economic and cultural value attributed to new economy jobs such as web and software development, than about any inherent humanistic value those activities may have. There has been a general shift in Western nations towards STEM jobs (Jones & Schneider, 2009, p. 396) and this is currently reflected in the emphasis on getting more girls to pursue these careers. Any discussion of computer literacy needs to take into account these rhetorics surrounding the relative value of different types of literacy. Hence, sub-section 2.2.6 uses the sociological framework of Pierre Bourdieu to better theorize "computer literacies" not only as something acquired by individuals under specific conditions, but also as something unevenly distributed across a society which attributes value to them. The next section will explore the existing empirical research on games and technological enculturation.

1.1.4 Three Decades of Empirical Research into Gaming as Technological Socialization

Part of the work of this thesis is to explore how the purported relationship between games and computing has played out in Southeast England. Markets for consumer electronics vary by time and place, as do governmental policies regarding how computers are incorporated into school-life and teaching. What follows is a non-exhaustive review of some of the empirical evidence for the technological enculturation thesis introduced earlier in 1.1.1. This review draws from predominantly British and American contexts, which are not necessarily interchangeable, but culturally similar enough for this to be a productive exchange.

Studies conducted during the 1980s (Fifre-Schaw, et al., 1985; Mohamedali, et al., 1987) observed that children and teenagers in England - predominantly boys – were progressing through a sequential pattern of socialization which went from playing games, to using software, and finally onto learning a programming language. Even during this earliest period, games could be seen to play an "interest maintenance function" (Charlton, 1999, p. 4) in relation to computing. Studies of hobbyist scenes from different countries during the 1980s suggest that the activity of making games was a way in which predominantly young male hobbyists tended to display their coding skills to each-other using the computers popular in the 1980s (Veraart, 2011; Wasiak, 2012; Swalwell, 2012; Swallwell, 2008; Svelch, 2013). The 1990s saw the departure of easy-access coding environments offered by 1980s machines, in favour of much more technically advanced and visually impressive games. On the personal-computer platform, many commercially-released games could be "modded", with players editing or adding their own content to games – a practice which has also been considered as a means of informal IT learning (Seif El-Nasr & Smith, 2006; Hayes, 2008). Beavis and Charles (2007) cite modding as one of the "tinkering" aspects of PC game cultures which have led to some boys getting a "head start" or sense of naturalness with computers which benefits them at school and at work. The learning activities happening alongside or through gaming have clearly changed with time, in parallel to the form taken by the technology; machines in the 1980s emphasised programming single, discreet programs in the universal "BASIC" language, while personal computers from the 1990s onwards were more complex and modular affairs. Notably, the majority of these more concrete examples of technological enculturation relate not to the general activity of "digital gaming", rather to activities related to games played on the personal computer and not on consoles.

In a study of 263 American adults Bertozzi and Lee (2007) found that males were more likely to play "mental rotation" games (p. 193) to spend more money on games, and to score higher on an index of technophilia, indicating that "those who derive pleasure from computer environments are more likely to report high self-efficacy in relation to computer technology" (p. 200). Note that this is self-reported, so the findings should be viewed in terms of subjective confidence as opposed to ability. One school-based study (Kennewell & Morgan, 2006, p. 273) found a high correlation between "self-efficacy [3] with computers and self-efficacy with computer games" and that their data showed evidence that "computer gaming can generate a self-efficacy with technology which can increase attainment in other aspects of computer use." (p. 275). However, the authors also noted that; "…average attainment of boys and girls was very similar" but boys tended to present a more extreme variation in terms of low/high achievers (p.265). Joy Harris (2011) studied the effect of gender enculturation on women's "technological self-efficacy" and, despite reporting little obvious effect, some of her research participants were aware of early differential treatment by parents with regards to technology, for example in remembering male siblings being "showered" with "technological games and systems" by fathers (p. 101) a finding that resonates with earlier observations that computers have historically been positioned by both marketers and parents as boys' toys (Haddon, 1990; Cassell, 2002).

DiSalvo and Bruckman (2009, p. 276) administered a survey to 1,872 undergraduate students of both gender in America, and found that although 43% consciously connected their

[3] "Self-efficacy" is a term used in psychology to denote an individual's belief in their own ability to perform a task. This concept will be discussed in more detail later in the chapter (1.2.5).

interest in computers to their gaming, only 6.9% actually went on to major in computer science. They conclude that their findings support the theory:

> ... that computer scientists played more frequently, or differently than non-computer scientists. But when we look at our data it is reflective of larger social changes ... We suggest that it is not that CS majors have stopped gaming, but that now everyone is gaming. And that gaming has lost some of its cultural significance and its introduction into an exclusive community of practice that included computational practices. (p. 276)

Much like Elisabeth Hayes, DiSalvo and Bruckman's work indicated that it is no longer sufficient to suggest that the general activity of "gaming" is giving boys an advantage in technology-based fields. Biographical research methods might help us to better understand why - if gaming culture does indeed "masculinize" tech work - do a much larger proportion of young male gamers not aspire to jobs?

The fact that 99% of 8-17 year olds report having played some sort of digital game in the last six months (Internet Advertising Bureau UK, 2014) strengthens Hayes' argument that more attention needs to be paid to variations in play practices, to better ascertain who is learning what through or alongside their gaming. For example, the use of The Sims as an exemplar girl-friendly 'moddable' game raises questions about young people's access to different gaming platforms. The Sims games are available on consoles but it is only the PC versions that allow this level of user creativity. DiSalvo and Bruckman go on to develop the debate by illustrating how conditions of reduced access to computers and internet prefigure the relationships that some young Black American men may have with both gaming and computer science (DiSalvo & Bruckman, 2010). An unintended offshoot of the discussion around games, gender and technological learning is to cast boys in a gendered equivalent of the "digital native" discourse, which sees young people as naturally-skilled with technology, while effacing more subtle disparities in technological access and use (Kvavik, 2005; Margaryan, et al., 2011; Koutropoulos, 2011) already suggested by the stratification of ICT uptake along socio-economic lines – an issue discussed in the following section.

1.1.5 The Unsteady Uptake of ICT/Computing in British Secondary Schools

An additional perspective which may be drawn from the Department of Education figures on post-compulsory computing courses is that they are not only heavily male-dominated but also generally unpopular among young people of either gender. Figures for 2011-12 show ICT receiving a third of the amount of A-Level entrants as Business Studies or Geography, one sixth of the entrance rates of Biology – the most popular science – and roughly an eighth as many entrants as Mathematics or English. There is also a gulf in popularity between sub-disciplines; 10,700 students entered A-Level ICT courses in 2011/12 while only 3,700 entered Computer Studies/Sciences. The makeup of the Computer Studies cohort is considerably more male, but the subject itself is also among the five least popular subjects in terms of total enrolment (although this may be partly due to a lack of provision). Between 2011 and 2012, the ratio of Computing to Maths A-Level students fell from 1:2 to 1:20, with a 100:1 ratio of male to female students in both years (Brown, et al., 2013, p. 269). Noting a similar situation in Germany, Schulte and Knobelsdorf (2007) suggest that a singular focus on gender underplays how unpopular computing is more generally (pp. 27-28) and low enrolment figures have led to

concerns about skills shortages in the UK IT sector (Wells, 2012; Council of Professors and Heads of Computing, 2010).

Although computer-oriented A-levels appear dominated by boys, ICT is less so; being generally more popular among both genders and emphasising more everyday office applications instead of specialized technical skills such as computer programming. The relative unpopularity – and greater male-dominance – of computer science may be due to a legacy of boys learning programming as a hobbyist activity at home, coupled with lower levels of provision. During the 1990s, writing code had been de-emphasised in favour of an ICT which focussed around office skills which were less specialized and more applicable to a greater proportion of white-collar jobs, leaving many young people born during or after the 1980s to learn about the more technical aspects of computers informally, in their spare time. Educationalists Kennewell and Morgan (2006, p. 275) argue that ICT teaching in England and Wales "has often been characterised by step-by-step instructive approaches which may do more harm than good by teaching pupils that either they are not capable of learning autonomously or not permitted to". However, as of September 2014, the national curriculum was changed to incorporate computer programming across all state primary and secondary schools. This was despite a 2011 Ofsted report on secondary school ICT which suggested that many teachers of the subject were poorly equipped to teach programming at Key Stages 3-5 (Ofsted, 2011).

The Royal Society (2010) has similarly criticised the "design and delivery of ICT and computer science curricula in [British] schools" as "so poor that students' understanding and enjoyment of the subjects in severely limited". Female students were found to hold this view by studies conducted in both the UK (Pau et al., 2011) and Australia (Anderson, et al., 2008). Drawing on Pau et al., Clayton et al. (2012, p.384) suggest that many students - but girls in particular - view ICT curricula negatively because classes lack "fun and creativity" with "little difference between what is taught at the primary and secondary school levels". In evaluating the Computer Clubs for Girls (CC4G) initiative in southeast England, Fuller et al. (2009) note that - despite interventions in the form of "fun" informal after-school computing clubs - students retained a perception of formal ICT lessons as overemphasising "boring" everyday office/administrative activities (pp. 78-9). In addition, the informal learning that students undertake at home, while "messing around" on the computer, may - in some cases - cause attrition from formal studies on the subject. Based on research in Australia, Carter (2006) suggests that students disengage from IT courses when their own informal learning about computers surpasses what is on offer in school. Writing about the UK situation, Wells (2012, p. 9) concurs that ICT "has arguably become repetitive and boring to pupils, teaching similar content over and over again; with new and challenging learning arguably limited, our pupils (particularly our gifted and talented) become disillusioned with the subject".

Although research has suggested than many students find computing/ICT boring, this emphasis may be misguided in some ways. The frequent inclusion of game-making as a 'fun' entry-level programming activity within these subjects arguably leads to a situation where game-making is viewed solely as an offshoot of Computer Science and not as an interdisciplinary creative practice. Hayes and Games (2008) have suggested that this approach to young people's game development is faulty, because it encourages students to make small programs which do not actually function as fun, playable games. They argue that, as a result, students "may not have much motivation to continue making games or using their newly acquired programming skills" (p. 18).

In a review of their research to date, DiSalvo and Bruckman (2011) argued that a "one-size-fits-all" approach to making computing look "cool" does not suit young African-American men from low socio-economic status backgrounds, for whom getting a reliable job is the highest priority (p. 29). This mirrors Varma's (2007) response to Margolis and Fisher (2003). While Margolis and Fisher had highlighted issues of cultural identification in Computer Science - foregrounding the role of 'geek culture' in excluding women - Varma's work suggests that those findings were a result of only researching affluent white women at an elite university, for whom economic stability was not the highest concern.

A report on BME[4] uptake of STEM subjects in the UK (sciencecampaign.org.uk, 2014) showed that, although BME men are 28% less likely to work in STEM than white men (p. 2) computer science and medicine have the highest uptake among the STEM subjects (p. 41) perhaps due to the perception that these will lead to stable, well-paying jobs. The same report also suggests that "Black women from African or Caribbean backgrounds are more likely to take up STEM subjects than men from the same ethnic groups" (pp. 41-42) which illustrates the complexity of the situation, in that oppressions do not necessarily "stack" in simple, predictable ways. Uptake of ICT and computing at GCSE level in the UK has also been lower among "lower ability" students and those from backgrounds of increased socioeconomic deprivation, while the uptake of the more vocationally oriented ICT GCSE was higher among those from backgrounds of higher socio-economic deprivation (Rodeiro, 2012; 2010) suggesting a channelling of working-class pupils into more clerical uses of computers. The association between computing and high-achieving pupils could suggest that subject is inherently difficult, but the positive association between low deprivation and ICT/computing uptake could also indicate that students from more affluent households are bearers of "preparatory privilege" (Goode, et al., 2012) in relation to computer use – an issue that will be explored at greater length later in this chapter (1.2.6).

1.2 A Conceptual Framework for Intersections of Leisure, Technology and Identity

1.2.1 Techno-centric Masculinities and the Work/Leisure Relation

The theory outlined in earlier parts of this chapter characterises gaming as pivotal to some young peoples' relationship to computing; how computing sits at an intersection of work and leisure. Domestic leisure technologies are argued to play a role in determining how young people engage with more formal routes in computing careers, such as the Computer Science or ICT courses offered within schools. We are, therefore, confronted with a 'fuzzy' boundary between work (which includes education, for those below work age) and leisure; two concepts that are often regarded as distinct and separate. The definition put forward in Kaplan's Leisure in America: A Social Inquiry (1960, pp. 22-25) typifies this traditional, dichotomous view Kaplan describes leisure as something which is:

- viewed as being in opposition to work
- anticipated and remembered as something pleasant

[4] "Black and Ethnic Minority" is a commonly used generic term in the UK to describe people of non-white ethnic origin.

- voluntary, with minimal involuntary social-role obligations (such as childcare)
- closely related to the cultural values of the participants
- playful in some way
- associated with a psychological perception of freedom

Kaplan's definition encapsulates some common understandings of what leisure is. However, as Ken Roberts (1999) argues, this definition of leisure as something residual - or time "left over" - creates a false dichotomy which does not accurately describe most people's experiences in contemporary society, where changes to the nature of work require us to "ask repeatedly whether we need revise out notions about what leisure is" (ibid. p. 5). Kelly and Kelly (1994) suggest that rather than artificially segregating these concepts, activities should be understood within a "life-course framework". This approach, as Shaun Best (2010, p. 43) notes, encapsulates how:

> People develop a form of reciprocity between paid work and their other roles and identities found in their leisure activities. We experience a constant shifting balance between the dimensions of our lives. … In this approach, leisure is the representation of self by the use of a symbolic and pleasurable encounter with the environment.

This reciprocal relationship between work, life, and other activities may be particularly relevant when examining the lives of those whose careers originate from early hobbies - as is the case for several of those who participates in the current study. Any activity can be understood as leisure by its participants, according to their perception of their own role and identity (Kelly, 1981). Hence, those whose occupations are highly emotionally absorbing or identify-affirming experience a blurring of the boundary between leisure and work (Lewis, 2003; Guerrier & Adib, 2003). Whether work/home overlaps are experienced as stressful or enriching depends heavily on the individual context (Greenhaus & Parasuraman, 1999). A job stemming from a hobby may be subjectively experienced as an extension of that hobby, meaning that practices such as "taking work home" may seem less intrusive.

This was one finding of Dovey and Kennedy's (2006) ethnographic research at one game development studio, where workers were found to share "a surprisingly common set of backgrounds" (p. 60). Many of the game developers they interviewed had grown up interested in mathematics, engineering and Dungeons and Dragons; leisure activities which informed their professional identities as programmers or designers of gamers (p. 74). Willis' (1977) ethnographic work had previously illustrated a cultural continuity between the "rough" anti-school masculinities practiced by working-class British boys and the factories where many of them would eventually come to work. What these pieces of research have in common is an emphasis on the way that young men's formative leisure activities have, historically, fed into their identities in ways which configure their transitions between school and the world of adult employment.

Dovey and Kennedy describe their respondents' stories as biographies of "dominant technicities" within the games industry (p. 69). Technicity, a term adapted from an essay on William Gibson's early cyberpunk novels (Tomas, 1989) describes social identities which are defined in relation to particular technologies or types of technological use. One example of a prominent form of technicity within computing culture is the 'hacker' – a term now more often used to indicate some sort of illicit computing activity, but initially with a broader meaning of

"a person who delights in having an intimate understanding of the internal workings of a system, computers and computer networks in particular" (Malkin & Parker, 1993). The terms 'tinker' and 'tinkerer' also appear throughout this thesis as variations on 'hack/er', namely as these were terms used by some of the respondents to describe their preferred ways of learning and working.

The idea that certain technicities would be socially, culturally and economically rewarded within an increasingly computer-mediated society was a central theme in speculative fiction at the dawn of the public Internet (e.g. Gibson, 1984) but has recently become a topic of serious debate. The "digital divide" theory posits that society is becoming stratified based on patterns of technological ownership, access and use (Warschauer, 2004; Van Dijk, 2006; Selwyn, 2004; Ching, et al., 2005; Hargittai, 2010; Silver, 2014; Norris, 2001) which are usually shaped by existing patterns of inequality with regards gender, class and ethnicity. Jon Dovey (2007, pp. 2-3) argues that the development of the concept of technicity enables games researchers "to reintroduce embodied individual subjects into the debate, and crucially to talk precisely about the messy obdurate granularity of power relations that the friction free technophiliacs elide". Technicity provides a useful conceptualization of two-way interactions between technologies and users; how social identity mediates the gaming experience and vice versa. Jon Dovey and Helen Kennedy's (2006) theoretical use of technicity can be understood as having two components; a materialist focus on the sort of technologies which have been available to an individual throughout their lifetime and how this may determine their physical comfort and motor-skills. At the level of subjectivity, technicity describes attitudinal differences in how technology is understood and valued from person to person and group to group.

Subjectivity can be understood as "the dimension that the individual attributes to his/her acts by interpreting and reinterpreting the data of his/her existence" but also as "the dimension of the individual's membership of the social circles within which his/her discursive practices take place" (Jedlowski, 2001, p.32) Here, the former definition describes the subjective experience of the individual whereas the latter speaks more broadly of subjectivities as shared states of being and knowing. This can include attributing to oneself an elective label, indicative of a type of technicity ('techie', 'geek', 'gamer') and the assumptions of group similarity that accompany such an affiliation. One key area broached in the second data analysis chapter (Chapter 4) is the way in which IT workers use assumptions of shared subjectivity to talk about 'typical' members of their profession. Similarly, existing literature often locates 'computer geek' identities in a broader context of 'geek' cultural consumption such as table-top roleplaying games (King, et al., 2003; Dovey & Kennedy, 2006; Tocci, 2009).

The concept of technicity provides a useful metaphor for the types of technology-focussed identities which appear to emerge throughout the life-course frameworks of some individuals. When a person identifies as a 'computer person' or 'techie', these are often lay-expressions of types of technicity; identities which exist not only as embodied, individual experiences, but also as stereotypical ideals circulated within popular culture. 'Techie' – a term I adopt not only for its legibility within Anglophone cultural contexts but also because it served as a self-identifier for many of the research participants – is a technicity often formed through both 'playful' and 'serious' activities. Individual experiences of gaming technologies are heterogeneous and these types of leisurely interactions with technology have a diversity of possible outcomes. The concept of technicity allows us to look at how recognizable identities such as 'techie' crystallize around shared biographies of these types of leisure-work interactions. 'Techie' or 'computer geek' are notable lay-expressions of types of technicity because they never refer solely to a type of masculinity (Margolis & Fisher, 2003) or whiteness

(Bucholtz, 2001) but to a constellation of overlapping and intersecting identities. For example, qualitative research with American teenagers has identified how white and middle-class boys are more likely to foreground gamer and/or computer geek in their public identities and relationships with peers (Sims, 2014; DeVane & Squire, 2008; DiSalvo & Bruckman, 2010; Seiter, 2008). For this reason, social class will be foregrounded as an often under-explored variable in the formation of techie identities for the remainder of the chapter.

1.2.2 Computer Hobbyism as a 'Career of Serious Leisure'

One possible contention with the existing theory of games as techno-enculturation is that it tends to paint in quite broad strokes, neglecting to illustrate why so few gamers actually go on to develop an interest in computing (DiSalvo & Bruckman, 2009; Hayes, 2008). It would be productive to begin differentiating between cases where gaming is experienced as escapist hedonism, and others where it is viewed more seriously, occurring within or alongside a context of hobbyist computing unavailable to the majority of young people who play solely on consoles.

Stebbins (1982) offers the concept of 'serious leisure' to describe a subset of leisure activates which participants experience as particularly identity-confirming. This is contrasted with 'casual' leisure (1997, p. 18) concerned primarily with fleeting instances of play, relaxation, entertainment, social interaction and/or sensory stimulation. Serious leisure describes the activities of those who turn to leisure (rather than work) as their primary source of self-identity and self value (ibid. pp. 252-253). Stebbins' formulation of serious leisure uses the concept of a leisure 'career' - a term usually associated with work but sometimes used to describe individuals' engagements with a set of activities or way or thinking over the life-course; as in Erving Goffman's (1961, pp. 127-128) use of "moral career". For Everett Hughes (1937; 1958) the term 'career' functioned as a "heuristic applicable to a much wider range of situations than is typical of current usage" (Barley, 1989, p. 45). For example, Howard Becker also talked about 'careers' of deviance in his book Outsiders (1963, pp. 31-35). Casual leisure is usually immediately rewarding and requires no special knowledge or training, but provides no long-term "leisure career" (Stebbins, 1997, p. 18).

As Valentina and Lyon (2011, p. 1030) argue in their review of 'career' as a sociological concept, this broader definition allows us to grasp "the interplay of opportunity structures and the ways in which people navigate them" as well as seeing career as a "site through which institutional processes might be viewed". Stebbins' understanding of leisure careers is particularly useful for the present investigation insomuch as it allows for a focus on the ways that leisure is differentially experienced and valued and thus how the subjectivities associated with leisure might interact with careers of education and work. Serious leisure may not always be pleasurable; and this type of leisure may be marked by a committed endurance of stress or boredom in lieu of deferred gratification (Stebbins, 1992). Serious leisure careers often involve the perception of an ongoing pleasurable challenge:

> One quality of serious leisure distinguishing it from unserious forms is the occasional need to persevere at it. … it is clear that the positive feelings about the activity come, to some extent, from sticking with it through thick and thin, through conquering adversity. (Stebbins, 1982, p. 256)

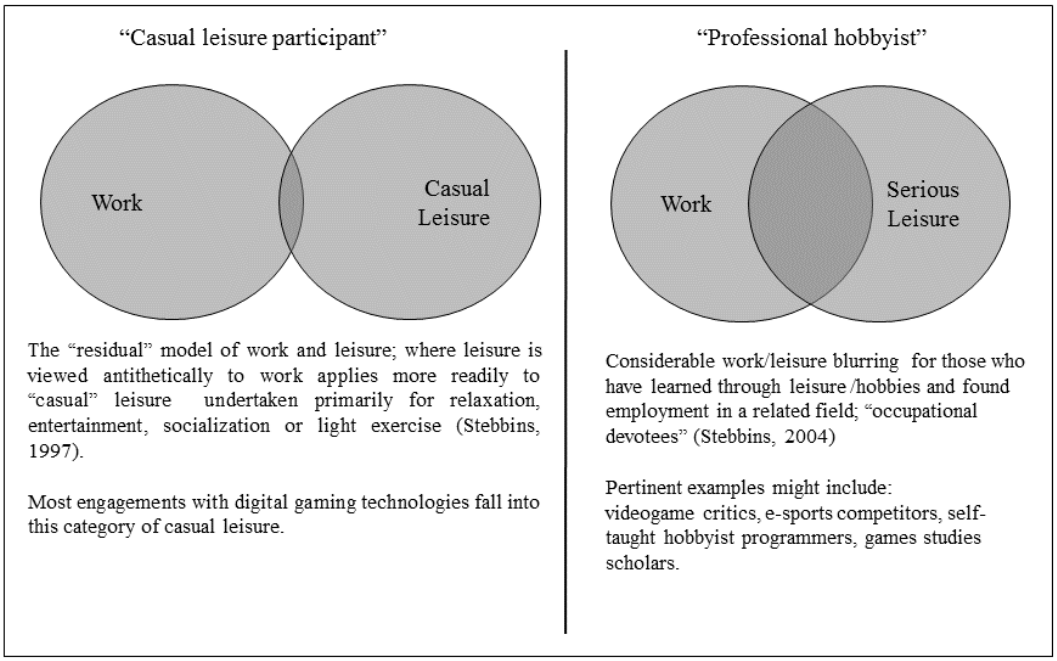
Different forms of serious leisure yield different types of rewards. These rewards are not only satisfying in themselves but also compensate participants for the costs and stresses associated with undertaking the activity - such as study, training or financial expenditure (Stebbins, 2001, p. 13). For example, histories of hobbyist programming scenes during the 1980s have stressed how part of the enjoyment derived from these activities had lain in evidencing a type of technicity (Švelch, 2013) "showing off" to peers what one was capable of doing; a pay-off for long sessions of solitary study and practice. In relation to the present study, this kind of activity was characterised by several of the participants as 'tinkering' – a term I adopt throughout the thesis because it preserves the interviewees' own language while also being a commonly used term for this type of technical learning-through-doing.

Leisure activities are not inherently serious or casual, but are experienced as having varying degrees of subjectively-understood seriousness. However, a more serious orientation towards an activity many view only as escapism might have real effects in terms of skill acquisition and career trajectory. While most people play digital games casually, for enjoyment and escapism, examples of more "serious" engagements with the medium could include:

- Participation in competitive videogames (or "e-sports") tournaments.
- Playing imported Japanese games to supplement the learning of Japanese as a language.
- Writing reviews of games, uploading footage, or otherwise engaging with online communities of videogame fans in as an amateur or semi-professional journalist e.g. making gaming "paratexts" (Consalvo, 2007)
- Gaming which occurs within or alongside a context of hobbyist computing/programming.

The last of these examples best describes the types of phenomena pertinent to this thesis. "Serious" gaming is generally not platform specific - the Japanese-learning example is likely to be better facilitated by consoles due to the fact that the Japanese games market leans heavily toward consoles - but the hobbyist-computing example is specific to the PC. This platform-specificity is explored in greater detail in 1.2.3.

Fig. 1: Diagram of author's adaptation of Stebbins' model of leisure to different types of digital gaming



The serious leisure framework arguably re-evokes the false dichotomy between leisure and work critiqued in earlier paragraphs, although perhaps it is more the case that the work/leisure relationship boundary is stronger or weaker on a case-by-case basis. The framework helps to address cases where leisure has some of the qualities traditionally associated with work (Beatty & Torbert, 2003) but may falter categorizing activities like sports fandom, which are experienced as serious long-term careers (Jones, 2000) but which do not necessarily fulfil all serious leisure criteria. However, the casual/serious leisure distinction provides a way to understand how activities related to digital gaming may be experienced and understood differently by their participants. Within gaming culture itself, such a distinction is often made through the language of "casual/hardcore". However, as discussed earlier (1.1.2) the casual/hardcore binary carries with it a history of exclusionary popular usage which limits its theoretical usefulness.

The serious leisure framework - with its emphasis on leisure careers as subjectively experienced by participants - moves the discussion away from the assumption that types of technical learning are intrinsically related to gaming, and toward a focus on how such links are made in specific social contexts under particular conditions of engagement. Perhaps cases where leisure is experienced as 'serious' are often the ones where distinctions between work and leisure are at their most blurry. Entering a field as a self-taught hobbyist suggests an erosion of these boundaries which may not be experienced by those in jobs where no history of hobbyist learning exists, such as lawyers or surgeons. Stebbins refers to such individuals as 'occupational devotees' (Stebbins, 2004), those who identify strongly with a serious-leisure activity and who have managed to gain a livelihood from it. Several of the participants in this study could be accurately described using this term; they were people who had been engaged with hobbyist programming and computer building since childhood or early adolescence, and who had gone on to work in related industries. Occupational devotion describes the slippage between work and leisure which occurs in life-courses where pleasurable youthful hobbies are successfully transformed into paying work through combinations of formal and/or informal learning.

Informal learning - such as self-directed learning undertaken by serious leisure participants - has been argued to provide access to "tacit knowledge"; knowledge which is not

wholly cognitive and must be felt (Polanyi, 2009; Livingstone, 2006). Learning informally may entail the acquisition of not only relevant skills and knowledge, but also attitudes and values associated with a field (Wain, 1993, p. 63). In cases of informal learning, the psychological "locus of control for making decisions regarding the goals and means of learning" rests upon the individual as opposed to any outside tutor (Mocker & Spear, 1982). Hobbyist activities sit at this intersection between leisure and informal learning, which are both associated with freedom and self-direction, standing in contrast to schools and workplaces, where individuals are more strongly constrained by institutional rules and values. However, people face social, cultural and economic constraints on their use of leisure time, meaning that hobbyist learning should not be prescribed as a one-size-fits-all ideal for all to aspire to.

The previously described slippage between leisure and work identifiable in many computing careers is key to understanding the culture surrounding IT as a professional field. Popular images of the computer geek tend to suggest an individual whose work and leisure lives do not show such a clear separation as those in other fields. Although the stereotype of young computer experts as male and antisocial has been challenged in the UK (Schott & Selwyn, 2000) a perception that those following computing careers should demonstrate a "myopic focus on computers" has figured strongly in some women's feelings of alienation from university computing cultures (Margolis & Fisher, 2003, p. 75). During the 1980s, it was suggested that boys had more access not only to computing as a specific hobby, but to hobbyist learning in general (Haddon, 1990; Deem, 1986). When the "enthusiastic hobbyist" pathway is normalised across sections of industry and academia, this can lead to a position where some demographics are positioned as default outsiders. As DiSalvo and Bruckman note of the early-adopting hobbyist:

> While their pride in their abilities maybe rightfully placed, it places those who don't have this early passion as the "other" in computing culture. This means students identify two types of CS majors, those that are connected to computing and the "others", those who did not experiment and participate in communities of practice. These outsiders to CS often come from homes, cultures, or have a gender identity where early and frequent exposure to computing was not encouraged or expected. (DiSalvo & Bruckman, 2010, p. 61)

Leisure participation is highly constrained by patterns of income (Critcher & Bramham, 2004, pp. 37-8) while the expectation to be caring continues to dictate what many women do in their free time (Henderson & Allen, 1991; Harrington, et al., 1992; Miller & Brown, 2005). Women often feel less entitlement to leisure (Henderson & Dialeschki, 1991) and may feel more guilt when wishing to engage with solitary activities such as using a computer (Burke, 2004). The use of leisure time for self-development has historically been associated with males and those with higher income (Seltzer & Wilson, 1980). For these reasons, Stebbins suggests that serious leisure has a "built-in class bias, skewing overall participation toward the more moneyed and educated groups" (Stebbins, 2007, p. 62) but also notes that not all serious leisure activities are necessarily expensive; observable differences in how different socioeconomic groups engage with 'serious' leisure may have as much to do with disparities in the availability of different forms of literacy and cultural competence. For example, many forms of serious leisure may require little financial outlay, and more to do with the use of after-school clubs and publicly-funded libraries.

Annette Lareau's (2011) research into American families found that middle-class parents tended to practice 'concerted cultivation', being heavily involved in dictating their children's' out-of-school activities and channelling them into the sort of activities Stebbins would have described as serious leisure. Working-class parents, on the other hand, tend to adhere to what Lareau terms the principle of "natural growth", where children are not projects to be worked on and are allowed to entertain themselves in whatever way they enjoy. This is related to having less money and free time, but also a difference in values. In other words, middle-class youth may be more likely to gravitate toward leisure activities which are somewhat 'work-like'. Lareau's findings, which have been replicated in the British context (Irwin & Elley, 2011; Vincent & Ball, 2007) might help to explain classed patterns of serious leisure participation.

While games studies has often been primarily concerned with games themselves as an object of study, I use 'gaming' to denote the activity of gameplay as a more general type of leisure activity. This allows us to step back and consider players' ongoing interactions with specific platforms, interrogating the ways in which those platforms provide or limit opportunities for informal learning. It is for this reason that the term 'gaming' will tend to take precedence over 'games' throughout the thesis.

1.2.3 The Materiality of Gaming Technologies and the Platform-Specificity of Player Cultures

It has often been the case within games studies that the differences between gaming platforms are underplayed in favour of a more inclusive definition of digital games. Consider the following semantic clarification made by King and Krzywinska (2006, p. 230) in Tomb Raiders and Space Invaders: Videogame Forms and Contexts.

> We use the term 'videogames' in this book to encompass what are sometimes separately described as 'computer games' (a term associated with games played on personal computers) and 'video games' (associated with various console platforms), also sometimes termed 'digital games'.

This semantic position is a necessity in order to focus on games as an object of formal study in their own right. The use of a single, all-encompassing term has allowed games researchers to analyse the mechanical and narrative qualities of specific games or genres without necessarily engaging with the technological platforms which enable those play experiences, or upon players. As Bob Rehak puts it, digital games can be understood as "conceptually separable from their technologies" and as "possess[ing] timeless formal qualities which remain recognizable from one instance to another" (2007, p. 141). However, the present study necessitates a stronger distinction between platforms, because so much of the existing evidence for games as inculcators of technical ability has shown PCs to have greater affordances in this regard. Despite these differences, research supporting the idea of gaming as technological enculturation has rarely foregrounded the importance of the platforms themselves.

Within game studies itself, there have been competing ideas about which elements of games are the discipline's most important foci. In the first issue of Games and Culture, Tanya Kryzwinska (2006, p. 119) argued that game studies necessitates a pluralistic approach in order to accommodate competing ideas about which elements of games should be studied. I extend this concern to the technological platforms which enable play, because – as is a key argument of this thesis – players' relationships with particular technological platforms have a knock-on effect in terms of whether or not they are given opportunities to actually make digital games and/or other forms of software.

One school of thought applicable not only to games but to digital technology more generally is 'platform studies'. Platform studies takes a social constructivist approach which asserts that society and technology affect each other mutually (Bogost & Montford, 2009). Laurie N. Taylor has argued that games studies have often overlooked the symbiotic relationship between the materiality of gaming platforms and the communities which arise around them:

> Computer and console games differ in use and in the cultures that they create because of differences in game-play, game usage, and game type […] The differences between console and computer gaming communities are formed through the game interfaces, the spaces of game play, and through player perceptions that often mislabel consoles as boys' territory and computers as systems for girls or older players. These difference gaming communities are then fostered through online and face-to-face discussion, magazines targeted at particular platform players, and through player perceptions on the types of games that belong on a certain platform. (Taylor, 2007, p. 223)

Taylor goes on to note that academics in games studies have tended to focus on games associated with the personal computer – due to having increased access to these and to their player bases - but suggests that in doing so they are often in danger of making general claims about digital games or gaming culture which are based on a specific and unrepresentative sample. It can also be argued that the tendency of researchers to focus on 'massively multiplayer' games such as World of Warcraft (Blizzard, 2005-) lies in the broader sociological appeal of such game worlds, while underplaying how such game genres may actually be relatively niche and non-representative of most peoples' experience of gaming. For example, large qualitative surveys in Norway (Hovden & Klevjer, 2012) and France (Rufat, et al., 2012) have begun to explore how social class intersects with other identity categories – such as gender – in determining the what, where and how of gameplay, and the results tend to suggest that some of the more popular platforms and genres are underserved by academic analysis of games.

The platform studies approach taken in the present study is an example of the 'material turn' in game studies (Apperley & Jayemane, 2012) given its focus on the technology itself and the players/users of that technology. Whereas game studies has tended to focus on the formal and representational qualities of games themselves or the "notion that games are virtual aesthetic experiences" (p. 15) Apperley and Jayemane cite studies of game platforms and ethnographies of players as examples of materialist game research. The stance taken throughout this thesis is that player cultures are inextricably bound up with the materiality of the technological platforms that facilitate their play, and that this symbiosis is integral to understanding the role that games may play in technological enculturation for some young

people. The remainder of this section will discuss relevant differences between consoles and PCs, as well as the player cultures associated with both.

The salient differences between consoles and personal computers can be understood in terms of openness of design, both in terms of the physical hardware and the operating system. Consoles have traditionally been closed systems which are built to run only proprietary software sanctioned by the manufacturer (Kerr, 2006) and more recently other entertainment media such as films and music. Console manufacturers - such as Nintendo, Sony and Microsoft - have tended to hide away their machines' inner workings in order to minimize technical barriers to entry, thus allowing for the largest possible target market. Inversely, personal computers are more flexible systems which tend to be assembled and upgraded piecemeal. As a result, those involved in PC-specific gaming cultures often express pride in their own gaming activities being in some way more creative or technical, as evident in Bart Simon's (2007) ethnography of players who physically modify their computers. As well as being more open in terms of their physical hardware, personal computers have an architecture which affords greater access to the individual files constituting a game's content, allowing players to alter or create new game content; a process which can potentially lead to a great interest in - or understanding of - game programming (Seif El-Nasr & Smith, 2006; Beavis & Charles, 2007; Hayes, 2008). These platform-specific differences work to constrain or simplify the end experience of use in ways which attract particular groups of players.

The PC has traditionally been associated with early adopters and innovation which trickles down to consoles. Online play is one such technology which was used on personal computers for around a decade before it came to consoles (Kirriemuir, 2006). PCs have been positioned as more of a niche gaming platform than consoles, perhaps due to the latter being more accessible and, in many cases, cheaper. Trends in games sales reflect this. For example, for the period 2006-2011, Nintendo's Wii and DS platforms (usually marketed as accessible and family-friendly) sold the most games, while the PC ranked lower than the consoles on sales by platform (Babb & Terry, 2013, p.40). Writing in 2006, Kerr (p.39) noted that console games made up a 57-78% majority of total global software sales, with some local variation (Europe has historically had a slightly larger PC-gaming market and Japan a smaller one). In a chapter on game platforms in The Oxford Handbook of The Digital Economy, Lee (2012, p.85) indicates that PC games make up "less than 5 per cent of videogame software revenues". In late 2013 it was revealed that Valve Industry's PC-gaming network Steam was catching up with console competitors, with 65 million accounts, in comparison to 48 million on Xbox Live and 110 million on PlayStation Network (Prasuethsut, 2013)[5]. Although such figures are cited as evidence of the PC's growing popularity, they still suggest that the most popular PC gaming network is only half as popular as those on console platforms owned by Microsoft and Sony (while totally discounting the popularity of Nintendo, which is arguably the most accessible and popular console brand).

Number of users or software sales only tell part of the story, however. In April 2014, PCR Online reported that PC games had surpassed console games in terms of global revenues (Sacco, 2014). This, suggests Sacco, is because consoles are a luxury item while PCs are viewed more as a household necessity - having a broader range of non-entertainment uses - and also because the PC has benefitted from new game genres and business models. In his book Fanboy

5 These figures only reflect account ownership, rather than activity.

Wars, Forbes tech and gaming journalist Paul Tassi characterises the PC gaming demographic as experiencing a transition away from its technologically-elitist roots;

PC players also dismiss console players as "casual", because PC gaming takes far more investment, both technical and financial, to build and maintain a great gaming rig. But there's a schism starting to form within PC gaming, between those running $1000 to $2000 PCs, that can play graphically intensive games on maximum settings, and those playing popular PC titles with regular laptops or desktops. Games like Hearthstone (2014) DOTA2 and League of Legends (2009) do not require high-performance machines to run. They also comprise some of the most popular games in the world right now. (Tassi, 2014, pp.7-8)

Despite these ongoing changes, the PC has historically been a less accessible and therefore less popular gaming platform. The casual/hardcore dynamic evoked by Tassi was discussed previously (2.1.2), but the academic discussion of these terms has tended to focus mostly on the more dramatic tensions between an imagined male "hardcore" player of PCs and consoles against a newer, often female and often older player of "casual" genres associated with mobiles and motion-controlled consoles. The image of PC as an excessively "hardcore", inaccessible niche platform is compounded when cost is taken into account; building a PC to the budget of a comparable console is a challenge. For example gaming site IGN (2011) ran a cost analysis on the price of maintaining a similarly powered PC and games console over a three-year period[6]. They found that the PC was only marginally more expensive (£2976.15 for PC, £2604.18 for console). However, IGN included the cost of a £249 HDTV in their analysis, on the grounds that it was required equipment - neglecting that many console purchases are an addition to a previously-owned television. Gamespot (2014) ran a similar build competition between several of its writers, concluding that a PC could be built for the price of the new Xbox One, but neglecting to include the price of a monitor as well as the part upgrades or replacements which might be expected over the years. Increased uptake of games consoles by the elderly and housebound has been attributed to their low cost, ease of use, and their utilisation of televisions which people already own (Kirriemuir, 2002). When considering the domestic economics of gaming machines, televisions are usually owned prior to the purchase of consoles and, as such, should not be included in platfrom comparisons in the same way as PC monitors. Another article compared the price of 6 'budget' gaming PCs (Advisor, 2015) recommended machines ranging between £549 and £611; at least £120 more than the initial release prices for the Xbox One and PlayStation 4 consoles.

It is this level of inaccessibility which has allowed PC gaming to function as a site of informal or incidental learning; PC gamers learn about their machines as they build, dismantle, and upgrade them – further examples of these kinds of 'tinkering' or informal technical learning are given throughout Chapter 3. All of the above evidence points to the PC gaming niche being comparatively smaller than the console gaming audience, while generally spending more money on games. The greater amount of resources spent by PC gamers, in terms of money and time, would suggest a particular social demographic, likely those households with above-average income.

Gaming platform preferences can prompt antagonism in some quarters of gaming culture. In some ways, loyalty toward specific brands or platforms is a normal part of videogame culture akin to supporting a sports team. For example, at the time of writing,

[6] including the cost of 47 games

Gamespot.com hosts ten discussion forums, with "System Wars" being the most popular[7] of the ten in terms of volume of posts. A web-search using loaded comparative phrases like "consoles better than PCs" (or the inverse) yields many discussions about gaming platforms, which cannot be adequately catalogued and analysed here. What does emerge, from a short review of such discussions, is that viewpoints tend to revolve around economic issues (which platform is most cost effective, which has cheaper games) and technological ones (which platform can run the newest games best, which platform can run older games). The "socialness" of the different platforms is also contested – with some console gamers not accepting the online-only variant of PC social play as truly "social" in the same way as console multiplayer games where several people can play on the same machine, or on online console networks where voice chat is the norm.

Most of the available data on player demographics is from America and is discussed in the earlier literature review. Research specifically on PC gaming communities has found them older (Williams et al., 2008, p.1007) and more gender-diverse (Llamas, 2014) than often assumed. However, such trends cannot be directly transposed onto younger gamers (understanding patterns of early gaming is, after all, the main focus of this thesis, even if some older respondents are offering their retrospective experience). For example, Gillian Andrews (2008, p.206) surveyed 195 American high school students, finding that those from higher socioeconomic backgrounds were more likely to report an interest in gaming as a whole, and were also much more likely to prefer PCs over consoles, compared to peers. As Andrews puts it:

> The digital divide appears to still manifest when it comes to computer games. This may be in part because of the quality of computers and Internet connections to which low-SES students have access, and in part because of a discomfort with keyboard-based interfaces. (p. 209)

It is possible to argue, therefore, that class is as salient a variable as gender in defining whether and how young people play. Kline et al. note a 1994 study of American households, finding that homes owning a PC but not a console were generally "older, less likely to have children at home, predominantly white, and possessed of a much higher income." (Kline et al., 2003, p.183). In the early 2000s, one British study of 1,287 6-17 year olds found that working class families were more likely to own a games console than were middle-class families (Livingstone, 2002). Although these patterns may change over time, they appear to reflect classed patterns of parental media policing, where consoles are viewed as a mass-market "trash" medium and negatively associated with "couch potatoes", while computers are championed by middle-class parents for their associations with work and learning (Itō, 2009, p.35). Gaming preferences appear to be mediated by parental social class, insomuch as middle-class parents tend to police their children's gaming more stringently (Irwin & Elley, 2011; Vincent & Ball, 2007)

Writing about an after-school computer lab in the US in 2005, Ellen Seiter observes that "for working-class Black and Latino boys, game consoles are more familiar domestic objects

[7] Not every thread in System Wars is directly related to this kind of animosity, but most do revolve around comparisons of what technology, system or brand is "better" or more financially successful. The overarching theme seems to be participants sharing knowledge and opinions about trends within the games industry at large.

than are personal computers" (p.50). Thomas and Walkerdine's study of Australian girls (2002) found that girls were more likely to have access to PC over console games, and parents were more likely to discourage console play among their daughters with reference to the perception of "boys' obsessive and addictive play on console games… something which was clearly understood as unhealthy, causing extreme lack of social skills and certainly something they did not want to see in their daughters". The PC is also associated with "slower" genres such as management and strategy games which appeal to a limited niche of players who have grown up with them (Hovden & Klevjer, 2012, p.11; Juul, 2012, p4) and are, perhaps, more likely to be encouraged as educational play by some middle-class parents (Itō, 2009).

Socioeconomic status can determine not only access to gaming technology but also how is perceived. Itō (2009, p. 35) has suggested that young people's engagement with games is mediated by parental attitudes to technology; with middle-class parents more likely to champion personal computers as educational while negatively associating consoles with "couch potato" televisual culture.

Many game genres are specific to the personal computer (MMOs, MOBAs, RTS[8]) partly due to differences in user-input, but also to the comparatively late entry of consoles into online gaming. Gee notes that the control schema of the PC attracts some while repelling others and that "these matters are connected to their identities as game players" (2003, p. 34). DiSalvo and Bruckman (2010) found the young African-American men in their study did not see playing an MMO as a "social" experience as long-term fans might, due to having no access to or interest in gaming PCs, while Andrews' (2008, p. 206) survey of 195 American high school students found that that those from high socioeconomic backgrounds were more likely to report a general interest in gaming, and to prefer PCs over consoles. Andrews characterises this is a type of digital divide, exaccerbated by the relative quality of Internet connections and perhaps "discomfort with keyboard-based interfaces" among lower SES[9] students (p. 209). Studies in Europe find working-class males favouring a more limited range of sports, racing and shooting games (Hovden & Klevjer, 2012; Rufat, et al. 2012). Dovey and Kennedy's (2006) use of 'technicity' - as discussed earlier in 2.2.1 - provides a fruitful way to analyse these intersections of identity and technological aptitude. Technicity lets us consider how players relate to technology more generally, in this case how an association with specific platforms may enable or constrain their engagements with hobbyist computing.

Learning can be understood not only as an individual psychological phenomenon, but as part of an interaction between the individual and their environment. Computer hobbyism is an out-of-school activity through which some young people develop what literacy scholars have described as "centres of expertise" (Gee, 2004; Crowley & Jacobs, 2002; Hayes & Games, 2008). As Hayes describes, centres of expertise are structured through social interaction sparked by an initial personal interest which is - in successful cases - additionally scaffolded by adults who "provide experiences, and resources, which extend the child's expertise" (2008, p223). The term "incidental learning" describes situations where this type of learning happens as the by-product of some other activity (Marsick & Watkins, 1990) for example, acquiring knowledge of computer hardware and operating systems through assembling a machine intended for gaming. As Haddon noted in 1990, there was always a "social side" to computing (p. 5) with boys gravitating to the hobby as something serious but fun, while girls' computing usually had to be

[8] These genre acronyms are explained more fully in the glossary.

[9] SES - or Socio-Economic Status - is used almost synonymously with the term 'social class' in such cases.

"justified in terms additional to any pleasure which the activity might provide … the micro could not just be a "toy" as [it] could for "the boys"." (Haddon, 1990, p. 13). Brigid Barron (2004) similarly describes games as part of a male-dominated "learning ecology", a term which suggests that this type of learning occurs within contexts which are spatially, temporally and culturally specific. As Jonas Linderoth (2004, np.) argues "it does not make much sense to offer global claims about computer games and learning, simply because the meanings that players take from games are rooted in specific contexts of use".

Game designer Raph Koster (2014) argues that every medium entails various different modes of production, consumption and analysis. He theorizes a "human activity matrix" (p. 143) of collaborative, competitive and solitary activities which may be characterised as constructive (such as making a game) experiential (the different types of gameplay) or deconstructive (such as theorizing about games). Using Koster's framework as reference, we can similarly note how it is the activities associated with the construction (e.g. programming and development) of games which the techno-enculturation thesis is most concerned with. It is also these activities which are most tightly bound to the personal computer platform.

It is this specificity which has, as previously discussed, often been omitted or underdeveloped in existing discussions of games as gendered tools of technological socialization. While other researchers explore learning which occurs during specific instances of play, according to a game's design or content[10] and the value of bringing videogames into classrooms[11], the present study attends to the general activity of "gaming" as it relates to other computer-mediated activities. As noted in the previous chapter, there is lack of empirical research into "individual players' trajectories of learning and development of expertise" (Hayes, 2008, p. 222). In order to provide this, it is necessary to better delineate the type of relationship which is being suggested – one in which learning occurs at the intersections of playful domestic leisure activities, and in part transfers over into the 'serious' realms of school and work. We also need to better understand exactly what is meant by 'expertise' in relation to technology – to disentangle disparate definitions of 'computer literacy' and examine how these might be illuminated by existing theoretical perspectives in both psychology and sociology.

1.2.4 Limits of "Computer Literacy" as a Model for Understanding Technological Knowledge

We have begun to use theories of leisure to describe informal types of technological learning. It is also important to define the terms with which to talk about the pedagogical outcomes of such activity, in relation to skills and/or attitudes. One common way of speaking about this is to evoke the notion of computer literacy. Arthur Luehrmann (1982) an early computer literacy advocate, gives the following definition, which still summarizes the everyday usage of the term: "If you can tell the computer how to do things you want it to, you are computer literate". As Seamus McMillan (1996, p. 163) puts it, this definition "has the advantage that it admits of a

[10] As has been the focus in, for example Linderoth (2012) and studies reviewed by Arnseth (2006)

[11] Some proponents of Games Based Learning have suggested that video-gaming involves a particular emphasis on learning-through-doing which could be used to restructure formal education (Gee, 2003) while others have focussed more closely on the integration of specific games into existing school curricula (Kirriemuir & McFarlane, 2004; Egenfeldt-Nielsen, 2005).

continuum of computer skill levels and it also allows for a concept of computer literacy that is both technology and environment or context dependent." For example, an office worker, graphic designer and computer programmer all require different proficiencies. However, this context-dependency also renders all-encompassing definitions of computer literacy unhelpful (van Vliet, et al., 1994) because the popular usage often describes computer literacies in the singular. McMillan (p. 161) thus suggests that the term is a "misnomer that can seriously impair our ability to properly understand the concepts implicit in prevailing definitions of computer literacy".

The word literacy usually implies a communicative process of reading and/or writing, whether in the traditional sense, or in some newly computer-mediated way. Terilyn Turner (1993, p. 1) notes that: "literacy has been defined as the ability to read and write, functional literacy as the ability to read and write in a particular context. After that, it all gets very hazy." Literacy tends to describe the mastery of communicative processes "that are deemed valuable in particular societies, cultures, and contexts" (Warschauer, 1999, p. 1). From this perspective, Brian Harvey (1983) argued against Luehrmann's definition of computer literacy on the basis that 'literacy' connotes a base-level of knowledge required by everyone in order to function at all in society. Harvey uses the analogy of a car to illustrate that while most people drive, not all need to understand the machine's mechanical workings. Even as more interactions (shopping, banking etc.) move online, a singular computer literacy conflates these everyday activities with those performed by professional software engineers or network managers.

The understanding of literacy as a set of skills used in communicative processes presents additional problems when thinking of more specific activities associated with IT work, because not all of these are wholly communicative. For example; physically building a computer or network of computers is not a communicative process one would normally apply the concept of "literacy" too, and while this is an activity more associated with network managers than computer programmers, many would still expect the latter group to also have some experience of this activity. In addition, the input language used by a programmer is usually not the same as the end result that a user interacts with, or indeed the machine code which the computer itself understands. These issues aside, the primary problem with the concept of computer literacy is its tendency to homogenise different types of computer proficiency in a way which renders the term unhelpful and suggests one clear trajectory from easier activities to more challenging ones. It would be more accurate to observe individual's proficiencies with computers in a way which separates out the different aspects of computing (e.g. software and hardware).

Schulte and Knobelsdorf (2007) use a pairing of "use" and "design" adapted from Cecile Crutzen (2000) to describe a spectrum between two modes of interaction with computers, which they observed in their biographical research with university students. 'Design' describes types of interactions with computers which are more aligned with Computer Science, in which the participant is actively engineering software or hardware and feels like an insider in the culture of Computer Science. 'Use', on the other hand, describes more everyday end-user interactions with technology, such as surfing the internet or using Office software (this terminology is misleading, as the category of "use" also includes the use of high-end design software, e.g. for visual or audio design, where the computer is being used to design something other than software itself). To return to the metaphor of literacy, the spectrum of passivity-activity suggested by use and design could be seen as analogous to processes of traditional 'reading' and 'writing', as illustrated in Fig. 2.

Fig. 2: Table of 'Use' vs 'Design' orientations toward technology, adapted from Crutzen (2000) and Schulte and Knobelsdorf (2007)

Aspect:		Examples and explanation
Software	Use:	Software is used to parse or produce content but software is not the thing being produced. Software use ranges from basic digital literacies (e.g. use of Office programs, web browsers etc.) to the use of specialist software for media production.
	Design:	Software is the thing being produced through the act of programming e.g. software-focussed Computer Science activities such as the development of applications for computers or smart devices.
Hardware	Use:	Assembly and maintenance of home computers.
	Design:	Hardware-focussed Computer Science e.g. the design and creation of new hardware, or network infrastructures.

In the examples offered in Fig. 2, software use literacy perhaps best describes the typically communicative uses of computers (suggest by the subject title Information and Communications Technology as used in UK schools throughout the 1990s and early 2000s). Hardware is more difficult to delineate into use and design. Rather these examples are offered to illustrate the plurality of literacies that fall under the rubric of "computer literacy". If we are to better understand trajectories of player's technical learning, it seems necessary to section out different aspects of computer literacy and to investigate how different forms of "serious gaming" might support each.

1.2.5 Technological Self-Efficacy: A Psychological Perspective on Computer Use

One concept that has been used within psychology to describe individuals' interactions with computers is self-efficacy. Self-efficacy originates in the work of Albert Bandura (1977; 1997) and is defined as an individual's belief in their own ability to produce desired effects during a given activity. Bandura (1997) suggests four main sources of self efficacy:

- Past performance or "mastery experiences" e.g. experiences of success at a task.
- "Vicarious experiences provided by social models" e.g. seeing successes of those similar to oneself.
- "Social persuasion" e.g. being told verbally that one has "what it takes to succeed" at a given task.
- Mood is thought to be an important determinant in the acquisition of self-efficacy, and despondency will diminish someone's perceived self efficacy.

Those with higher self-efficacy set themselves more challenging goals, exert more effort, and are more persistent when facing new or difficult tasks (Bandura, 1982), similar to the positive reinforcement cycle implicit in Stebbins' understanding of serious leisure, where

pleasure often stems from the conquering of adversity (Stebbins, 1982, p. 256). Importantly, self-efficacy differs from a broader notion of "self-esteem" in that it is largely specific to tasks or families of tasks. Area-specific self-efficacy is, however, also affected by general self-efficacy which is more akin to "confidence" as an emotional state or personality trait (Eden, 1988; Shelton, 1990; Sherer, et al., 1982). Chen et al.'s (2001) study of psychology undergraduates showed that self-efficacy in computing was related to mechanical self-efficacy, but not in relation to art, persuasion or science. Self-efficacy is specific to a task or field, but types of self-efficacy are interrelated, particularly when the activities are perceived as being similar. Chen and colleagues' findings on inter-related forms of area-specific self-efficacy illustrate how mechanical interactions with computer hardware can lead to an increased sense of self-efficacy with seemingly unrelated aspects of computing (such as programming).

Self-efficacy has been a central concept in some studies of gender differences in videogame usage (Cruea & Park, 2012; Klimmt & Hartmann, 2006) and computer use (Harris, 2011). The studies echo previous findings about women's participation in traditionally masculine competitive sports (Lirgg, 1991) namely that those who are part of a cultural out-group tend to experience lowered self-efficacy, even if their concrete skills are the same as those within the in-group.

McDonald and Siegall (1996) use "technological self-efficacy" (or TSE) as a more general term for the interrelationship of skill and confidence in computer use. "Technological self-efficacy" provides a more thorough definition of the set of skills and attitudes normally inferred when describing an individual as 'computer literate'. Importantly, it also attends to the subjective dimension of feeling confident in one's own abilities - which is sometimes inferred but not always explicit when "literacy" is the central concept; "literacy" tending to connote an ability as opposed to a disposition or attitude. It encapsulates the general sense of confidence a highly computer-literate person might have when working with software of hardware, and the confidence with which they might press on through difficult tasks, even if they do not explicitly know how to resolve any issues at that precise moment. Diametrically opposed to technological self-efficacy is the state of "learnt technological helplessness" as used by Harris (2011) to describe female active rejection of male-coded technologies, also discussed in different terms in the work of Helen Thornham (2008) as well as Thornham and McFarlane (2011).

For all its merits, self-efficacy remains too individualistic a concept to fully explain the ongoing structuring of technoculture along socio-demographic lines. A purely psychological conception of computer efficacy places too little emphasis on the prevailing social, economic and cultural factors which limit people's experiences of the efficacy-building activities identified earlier. For example, the availability of "mastery experiences" will be dependent on material ownership or access to technology, while the availability of relatable role models will depend upon the current distribution of technological self-efficacy across society; for example in a lack of female and/or ethnic-minority teachers of Computer Science. As such, technological self-efficacy appropriately describes aspects of the learning process at individual and interpersonal levels, but fails to deal with some important overarching issues. It is necessary to bring to bear a sociological perspective on the transferral of knowledge and attitudes, and their prescribed value in contemporary society.

1.2.6 The New Technical Middle-Class in a Bourdieusian Sociological Framework

The existing literature suggests that social class can come to determine not only the availability of technology in financial terms, but also some of the attitudes brought to bear on whatever technologies are available (North, et al., 2008; Andrews, 2009; Seiter, 2008). Middle-class youth often acquire a type of 'head start' at computer literacy based on early domestic access to computers and knowledgeable adults (Ching, et al., 2005; Seiter, 2008; Schulte & Knobelsdorf, 2007) also described as 'preparatory privilege' (Goode, et al., 2012). The BBC's Great British Class Survey, analysed by Savage et al. (2013) identified seven social classes in contemporary Britain. Among these were the "technical middle-class"; those in relatively well-paying technical jobs, who have some high-status contacts but who are nonetheless relatively socially isolated. As Savage et al. summarize:

> We might see this class therefore as a group of scientifically and technically oriented people who have used their skills to gain reasonably secure and well-rewarded work, but who might not be seen as part of a more established middle class. Even though they are as likely as the established middle class to come from middle-class families, their degree of social and cultural disengagement is marked. We could see this group as indication of Savage's (2000) argument that in the second half of the 20th century we have witnessed the emergence of a distinctive technical group somewhat at odds with the larger section of the middle classes who are more oriented towards the arts and humanities. (p.237)

This group generally avoids living in central urban areas, and are shown to have a moderate amount of 'cultural capital', both in terms of traditional 'high' culture and contemporary pop culture. Cultural capital is one of three forms of "capital" described by Bourdieu (1986) whose theoretical framework is useful for understanding how different types of knowledge, ability and attitudes come to be unevenly distributed across society in a way which reproduces inequalities over generations. While "social capital" refers to interpersonal connections and influence, and "economic capital" to financial wealth, "cultural capital" describes objects, knowledge and attitudes which have some sort of (arbitrary or culturally-contingent) value within the dominant society; such as an appreciation for certain art and literature. Cultural capital includes "dispositions of the mind and body" as well as physical goods and institutional qualifications (Bourdieu, 1986, p47). The economic metaphor suggested by the choice of the term "capital" is intentional; Bourdieu's capitals refer to inter-exchangeable elements of an individual's power within society; the "balance-sheet of a power relation" (Bourdieu, 1984, p. 172). As Roberts (Roberts, 2009, p. 16) puts it, Bourdieu's application of economic language indicated how socio-cultural resources - such as knowledge of fine art or computer programming - "could also be accumulated and invested in the expectation of a dividend." The economic metaphor also extends to the relationship between scarcity and value, as Bourdieu explains; "Any given cultural competence (e.g. being able to read in a world of illiterates) derives a scarcity value from its position in the distribution of cultural capital and yields profits of distinction for its owner". (2000, p. 49).

For a relevant example of how the value attached to a form of knowledge derives from its scarcity, we can consider the value of knowing a particular programming language, or of knowing how to program at all, in comparison to the more everyday uses of computers taught

within the previous UK ICT curriculum described in 1.1.5. To use Bourdieu's terms in relation to the platform-specific type of gaming previously discussed in 1.2.3 - gaming on a PC may not always require more economic capital, but it requires particular forms of cultural capital i.e. the technical knowledge of how to build and maintain computers - as well as social capital in the form of relationships with knowledgeable peers or family. It is this set of capitals that have been associated with the "technical middle-class" described by Savage and colleagues.

Cultural capital is one of the mechanisms Bourdieu used to explain 'cultural reproduction' - the passing down of knowledge and dispositions from generation to generation, usually within the family home. It describes the ways in which certain types of privilege are 'kept in the family'. Jenks (1993, p. 12) describes this as "a cultural process that is self-sustaining and self-perpetuating" which acts to position some as "the 'natural' inheritors of cultural capital" in the sense that talents and abilities tend to seem innate even when they are the result of 'preparatory privilege' (Goode, et al., 2012). Cultural reproduction can often lead to social reproduction, in the sense that the children of middle-class parents tend to bring their domestically-learnt dispositions and tastes with them into the school curriculum. As a result, theories of socio-cultural reproduction serve to explain the "tendency for children to inherit their parents' class positions" (Roberts, 2009, p. 14).

Models of social class following Bourdieu's framework tend to be "bottom-up" or "inductive" (Savage, et al., 2013). They are not concerned with reifying the common understanding of class as a static pyramid of three groups (working/middle/upper) dealing instead with social groupings which emerge through analysis of data. The names given to such groups are approximate metaphors for real social positions, and which are subject to change, as in the case of the emergence of the technical middle-class (Savage, 2000). Cultural reproduction, in this sense, does not necessarily entail the endless reproduction of the exact-same class structure. Historical turning points such as the invention of the computer may potentially change society, but groups with some sort of pre-existing advantage will - consciously or otherwise - attempt to confer these advantages on their children. Reay (2013) notes the often subconscious effect of cultural reproduction on British youth's differentiated experiences of the education system:

> This is not simply an issue of material resources, the number of books, enrichment activities or private tuition sessions that middle- and upper-class parents can afford to pay for; it is also an issue of other, less visible benefits of affluences – confidence, entitlement, a sense of belonging within education – that come with a family history of privilege. (p. 34)

Thus, the forms of advantage enjoyed by children from privileged homes can also be attitudinal, rather than simply being about having more access to a type of knowledge. Bourdieu uses "habitus" to describe a set of dispositions shared by members of a similar social group. The effect of the habitus on attitudes and actions has parallels with the common expression that an individual is a 'product of their environment'. As Bourdieu (1984, p. 170) describes it, the habitus is a "structuring structure, which organizes practices and the perceptions of practices" but it is "also a structured structure" in the sense that an individual's habitus is a product of their particular social location during formative years. Hence, the individual develops a set of dispositions - the habitus - which is structured by these external socio-cultural factors and in turn structures their ongoing interactions with computers, allowing for a greater ease of entry to

the educational and professional fields of computing where many members share elements of the same habitus.

In Bourdieu's model, the habitus tends to meditate cultural tastes, so that those with the least access to a rarefied type of cultural literacy tend more often to reject it; for example in the case of the working-classes rejecting opera or avant-garde art as pretentious. This rejection, which can be understood as at least partly based on free will can nonetheless lead to the reproduction of the existing social structure (Bourdieu, 1987) in the sense that it is these 'pretentious' arts which are legitimised within the education system as what an individual needs to know in order to achieve qualifications. To use the stereotypical 'techie' technicity as a contemporary example; geeks tend to be those who have grown up with greater access to technology, and to peer and family networks where hobbyist self-tutorship is encouraged, while athletic pursuits are given less importance, yet activities often associated with geeks are also actively rejected by many other young people. They are, therefore, more likely to enter the technical middle-class, and are also more likely to be the children of parents from the technical middle-class.

Bourdieu has been criticised for making identity categories such as sex/gender, sexuality and ethnicity secondary to social class (Lovell, 2002; McCall, 1992). However, Lovell goes on to argue Bourdieu's use of habitus proves useful for describing how the realities of social structure often come to bear on individual psychologies. As Lovell goes on to describe:

> By habitus Bourdieu understands ways of doing and being which social subjects acquire during their socialization. Their habitus is not a matter of conscious learning, or of ideological imposition, but is acquired through practice ... Habitus names the characteristic dispositions of the social subject. It is indicated in the bearing of the body ('hexis'), and in deeply ingrained habits of behaviour, feeling, thought. (Lovell, 2002, p. 2)

The value of Bourdieu's habitus lies in collapsing artificial distinctions "between the dualisms of mechanistic thought and voluntarism, between mind and the body, between coercion and willed complicity" (Fowler, 2003). It renders redundant an either/or conception of sociology's structure/agency problem by suggesting that agentic individuals have their choices silently expanded or curtailed by unconsciously embodied dispositions they have acquired through childhood socialization. North et al. (2008) used this concept in relation to the digital media consumption practices of the Australian teenagers they studied:

> The link between cultural capital, habitus and cultural form produces a socially entrenched digital inequality rather than an economically entrenched digital divide …new experiences, objects, actions and accomplishments using digital technologies were accepted as valuable or rejected depending on how well they fit with already existing thoughts and processes incorporated into the young people's habitus. (p. 895, emphasis added)

Historically, computer-learning has usually required a solitary engagement with the machine, meaning that those who are comfortable with solitary, self-directed activities have the dispositions most conducive to obtaining an early start at computing. One seven-year study of 10,000 British youth (Hendry, et al., 1993) illustrates how young people from working-class

backgrounds were more likely to value peer conformity (p.126) whereas individualism was more valued among middle class youth (p.49). Hence, the solitariness of computer hobbyism may be an issue in itself, as the social penalty associated with solo computer use may be higher for working-class youth, a point made by Ellen Seiter (2008, p. 34) in relation to observations of American schools. These factors partly help to explain the "built-in class bias" earlier identified by Stebbins (2007, p. 62) in relation to the uptake of serious leisure activities associated with self-education – even for activities which are not financially expensive.

Seiter (2008) adapts Bourdieu's framework, comparing the home computer to a piano in the sense that both are technologies which require not only a large financial outlay but also space and "free time to fool around" in order to master (p.33). Critics of the idea that young people are 'digital natives' who instinctively understand computers have similarly found that many young people are afraid to learn computing by trial and error (Kvavik, 2005; Margaryan, et al., 2011) whether in relation to the physical dangers of hardware tinkering – such as electric shock or damage to expensive components – or the potential for making the computer unusable by inappropriately altering software settings. This leisurely type of learning - characterised earlier as incidental learning or a form of serious leisure - works to instil an embodied familiarity with the machine wherein "the relationship of the body to the object becomes automatic rather than conscious." (p.34). This sense of activity-specific familiarity or confidence - self-efficacy, to use the preferred term of psychology - can be understood as a form of embodied cultural capital which, in Bourdieu's view, can only be transmitted through slow inculcation, usually within the family home. This makes it more difficult to obtain than objectified cultural capital, because physical objects such as computer hardware can be instantaneously transferred from person to person. Cultural capital is the "best hidden and socially most determinant educational investment" (Bourdieu, 1986, p. 48) in the sense that it is difficult to transfer from person to person, and that such a transferral usually happens at home, unseen by those working in or researching formal education. As Stewart (2013, p. 69) summarizes;

> This embodied form of cultural capital is transmitted to the child in the home environment. Children exposed to prestigious cultural practices from an early age acquire cultural capital, often unconsciously... These embodied cultural competences are socially useful and confer scarcity value when the children are assessed alongside others whose early education has not been so intensive. The possession of high levels of cultural capital in its embodied state can secure symbolic and material profits .... high levels of embodied cultural capital enable one person to appear to be innately more capable than another. This is because embodied cultural capital seems to be natural and not something that has been learnt and acquired over time.

In Seiter's adaptation of Bourdieu to the home computer, the PC is positioned in a continuum of cultural objects including the piano and books[12], which are difficult to master and which require a type of habitus oriented around solitary study. While Seiter focuses on continuities between the types of socialization practices happening in the homes of the traditionally middle-classes

[12] sociological studies often use "number of books in home/parental home" as one index for social-class of origin in terms of parental cultural capital. In contrast, the BBC's Great British Class Survey used a combined measure of traditional cultural capital and "emergent" cultural capital, to acknowledge the growing role of activities such as the attendance of live pop-music performances in the British class system.

before and after the emergence of the home computer, it is also worth considering the technical middle-class as a specific, distinct group (Savage, 2000; Savage, et al., 2013).

Much of the literature explored so far in relation to the socio-demographic makeup of computing careers places emphasis on computing as a set of often solitary activities which are more oriented around the computer as a thing than around people. The findings of the Great British Class Survey seem to support this in their characterisation of British IT workers as comparatively socially isolated. However, situating computing on one side of a people/things binary may represent a gross over-simplification. As Haddon (1990, p. 5) argued, hobbyist programming was very much a social activity for the early young male hobbyists. Hobbyist programming is an activity which can be conducted in isolation, and the social aspect may often revolve a sort of competitive "showing off" of what has been made (Švelch, 2013). It might be better to consider a sliding-scale, where some activities are more or less people/things-oriented, but often a mixture of both.

Based on a study in Norway, Berg et al. (2002, p. 19) suggest that girls have tended to disengage from computing in school due to an ill-fit between solitary computer use and traditional ideals of female sociability. The idea that women are in some way inherently more people-oriented can be criticised as supporting potentially harmful biological essentialisms, but has also been a central assumption in feminist psychoanalyses of female rejection of computing (Turkle, 1986) and competitive forms of digital play (Walkerdine, 2007; Thornham & McFarlane, 2011). Media psychologists Cruea and Park (2012) argue that young women may be "less motivated to play video games to satisfy their need for social interaction" (p. 47) inferring that men have a greater need to use technological hobbies as a way to socialize, because traditional masculinity does not permit men to socialize for the sake of socializing. One study of US labour market trends from 1972-2010 (Lippa, et al., 2014) illustrates that women "continue to be found much more in people-oriented than things-oriented occupations at all job status levels" despite having increased access to formerly male-dominated, high-status occupations. While the authors conclude that this may stem from women becoming "freer to express their interests and values", their data still fails to validate a view of gendered dispositions as innate. Similarly, as discussed in 1.1.3 while Turkle's ideas about gendered psychologies (1986) are made in relation to cultural norms regarding mothering (Chodorow, 1978; Gilligan, 1982; Keller, 1983; Keller, 1985) rather than presented as innate and biologically determined.

It is at this point that gender and social class appear to intersect in terms of determining who is most likely to have the opportunity to become highly efficacious with computers. Those who have been raised to value athleticism and outdoor, physical activity may not feel comfortable engaging with sedentary computer-based hobbies (Seiter, 2008, p. 34) and young men from lower socio-economic backgrounds often reject the discipline for its associations with non-athletic geek masculinity, even if they show some promise at the subject (DiSalvo & Bruckman, 2010; Kvasny, et al., 2015). Earlier studies in America illustrated how some boys from poorer backgrounds associated computers with 'feminine' clerical work, and rejected computing as not fitting with more physical ideals of masculinity (Rojas, et al., 2004; Stanley, 2003). Economically disadvantaged youth also tend to place a greater value on overt symbols of consumerism such as branded-clothing (Isaksen & Roper, 2012; Sweeting, et al., 2012) which stands in opposition to the sartorial asceticism of the stereotypical geek. This combination of factors can mean that young people who are the most culturally distant from the normative white, middle-class male geek will self-exclude from activities they associate with this identity, even when given access to similar equipment and tutors (Bock, et al., 2013).

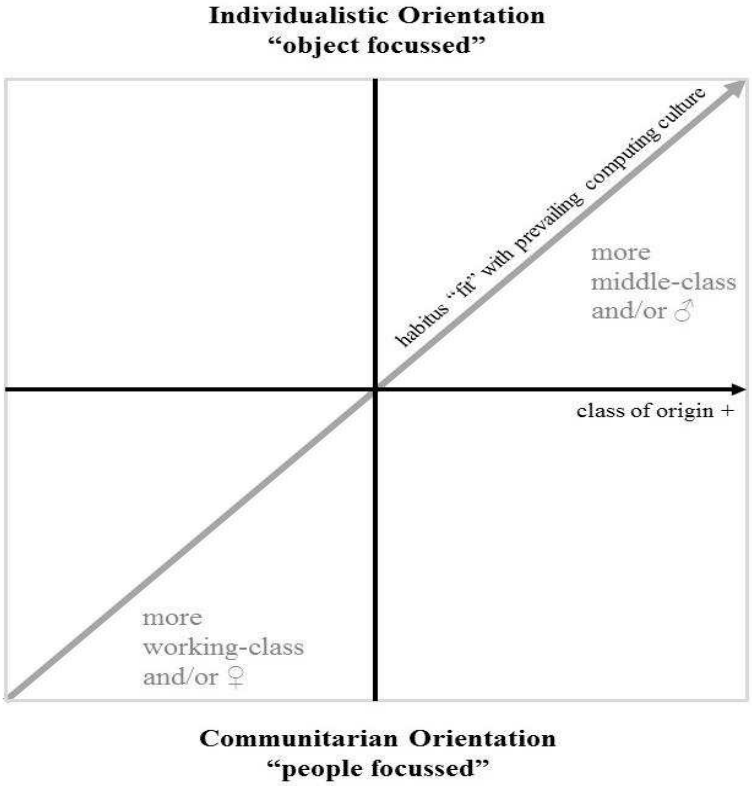
Young people from working-class backgrounds are also more likely to have parents who do not work with computers, or who are employed in "the more alienating forms of computer work" (Seiter, 2008, p41) such as administration. Attitudes to the computer can therefore be seen to relate to a class habitus which predates the computer itself. As Seiter (2008, p. 41) puts it "social class, ethnicity, and language interact with gender expectations in determining who likes to use computers." Working-class youth face a greater risk of "loss of social capital" when engaging with computing culture; "the penalty of being a nerd, a geek, a kid too identified with school and teachers" (ibid. p41). Bury (2011, p34) suggests that male tech workers live up to mainstream cultural expectations about masculinity and technological expertise, while also representing a 'failed' sort of masculinity in terms of social status and the way they are positioned in relation to more athletic and highly socialized men. The result is the archetypal 'computer geek' identity, often understood as a techno-centric (but in ways unattractive) type of masculinity.

We should, however, regard the stereotype of the asocial, scruffy geek not solely as an image which acts as a cultural gatekeeper to technology fields, but also as embodying a set of perceived practical requirements; a reflection of the sort of traits associated with someone who spends the majority of their time solving computing-related problems. 'Geek' is, after all, not just a stereotype but also a lived identity for many people. As ethnographer Jason Tocci (Tocci, 2009) argues, the term "geek culture" often entails a constellation of seemingly un-related activities such as science, video-gaming, comic books and tabletop role-play. 'Geek' can therefore be understood as a type of habitus which involves certain cultural capitals in the forms of skills and literacies, alongside attitudes to cultural consumption; many of which are drawn from a middle-class parent culture. While researchers of computing and gender frequently foreground a sort of identification-based image problem with regards technology and geek culture (e.g. Margolis & Fisher, 2003) this is arguably compounded by a uneven distribution of the "dispositions of the mind and body" (Bourdieu, 1986, p47) which might be most conducive to obtaining careers in computing. As Bourdieu puts it:

> It may be assumed that every individual owes to the type of schooling he has received a set of basic, deeply interiorised master-patterns on the basis of which he subsequently acquires other patterns, so that the system of patterns by which his thought is organised owes it specific character not only to the nature of the patterns constituting it but also to the frequency with which these are used and to the level of consciousness at which they operate, these properties being probably connected with the circumstances in which the most fundamental intellectual patterns were acquired. (Bourdieu, 1967, pp. 192-193) emphasis added)

If we combine the quite stereotypical view of computer science as a field where -usually male- individuals seek refuge from human relationships (Mellström, 1995; Håpnes & Rasmussen, 1991; Turkle, 1986) with the observation that middle-class young people gravitate more toward solitary, individualist pursuits than their working-class peers (Hendry, et al., 1993; Seiter, 2008) and are encouraged to follow such activities by parents (Itō, 2009; Lareau, 2011) a model begins to emerge, illustrated in Fig. 3.

Fig. 3: Diagram of Author's Theoretical Model of 'Computing Culture' Habitus



While there is a wealth of existing evidence of an active rejection of the field from young people falling outside of the intersection of socio-demographic categories to which the 'geek' label is often ascribed, it is also pragmatic to consider how a more specific combination of 'middle-classness' and 'masculinity' - as these are culturally understood in the present moment and context – entails such a strong leaning towards self-tutorage and 'thing-oriented' activities and careers. Bourdieu's concepts allow for an intersectional model which acknowledges multiple axes of identity in the construction of the type of habitus or technicity most frequently associated with the field of computing. The 'computer geek' should be understood not only as an exaggerated stereotype circulating within culture, but also as a type of habitus – a lived identity associated with a set of dispositions most conducive to solitary computer-learning and self-tutorage.

While the psychological concept of technological self-efficacy appears to adequately describe learning at an individual level, it fails to properly account for these external cultural factors, beyond small mention of 'role models'. A Bourdieusian perspective on the field of computing suggests that identities which might be called 'subordinate technicities' - identities outside of the traditional white male computer geek - are not only excluded by a lack of resources or role models, but also on the basis that they are less likely to have the set of dispositions valued by those already in the field - for example, the self-tutoring hobbyist

mentality inculcated by the types of hobbyist learning described in Stebbins' work on 'serious leisure'. It is not simply a desire to avoid classifications as a geek - a label often associated with social failure among teenage peer groups - but also because being a geek requires types of specialised focus which are an ill-fit with the existing habitus of these groups.

The data collected throughout the research process will, therefore, be used to further explore the idea that middle-class masculinity is an identity formation which currently best supports the activities required or expected by the field of computing - in this case, foregoing socially-focussed or athletic activities in favour of a largely solitary career of technologically-oriented "serious leisure". This should not necessarily lead to the conclusion that the current diversity in tech movement is futile. When children are given opportunities to "mess about" with technology without too much fear of reprisal (a privilege which has historically been afforded more often to boys) they develop confidence and learn to teach themselves. Rather, the idealised techie-hobbyist habitus/technicity can be understood as the result of decades of socio-economic and gendered privilege as manifested in terms of technological ownership and access, as well as social proximity to those already part of the technical middle-class. Following Seiter's use of a Bourdieusian approach to contemporary technoculture allows us to synthesise existing threads of research on gender and social class into a single model.

1.2.7 The Gaming-Computing Link in a Bourdieusian Framework

Although studies have begun to explore how social class intersects with other aspects of identity in forming young people's gaming tastes, this is rarely put in the context of the pedagogical aspect of gaming suggested by the techno-enculturation thesis. While the prevailing culture surrounding education and work in technology-related fields can be broadly described as 'masculine' or male-dominated, we should try to better understand how social factors shape a diversity of masculine identities in relation to technologies of leisure and work.

Ethnographic research with American youth (DiSalvo & Bruckman, 2010; DeVane & Squire, 2008) and larger surveys in Norway (Hovden & Klevjer, 2012) and France (Rufat, et al., 2012) have illustrated that young men from lower socio-economic backgrounds tend to have a preference for communal play, and are also oriented around a limited range of sports, racing and shooting genres, with traditionally masculine themes/characters. Hovden and Klevjer (p. 10) suggest that female engagement in "practices and products which are traditionally heavily gendered" is easier for girls and women from higher social backgrounds, with more inherited cultural capital. In an ethnography of an American high school, Christos Sims (2014) found that, although the majority of boys played games, it was the predominantly white, middle-class 'geeks' who most clearly foregrounded a 'gamer' identity. Andrews' (2008) survey of 195 American high school students found that those from higher socioeconomic backgrounds were more likely to report a general interest in gaming, and to prefer and have access to gaming PCs.

A key way that Bourdieu's concept of cultural capital has been adapted within games studies is Mia Consalvo's (2007, p. 18) notion of "gaming capital", which describes how "being a member of game culture is about more than playing games or even playing them well" but also about insider knowledge from relevant websites and magazines, as well as understanding historical references and in-jokes related to older games. 'Gaming capital' helps to illustrate how different individuals and groups engage with games in different ways, and also how 'gamer' may have a subcultural connotation beyond 'a player of games'.

Consalvo describes how some groups may be disproportionately and systematic excluded from the means to possess gaming capital - or the desire to (p.36; p. 124) but does not mention social class. The use of Bourdieu's terms in discussing the operations of a single group ('gamers') somewhat contradicts Bourdieu's original theorization of cultural capital, which was intended to illustrate "how taste and style preferences have the real concrete consequence of installing and reproducing social hierarchies on the basis of differences in social agent's ability to master the codes of the legitimate culture". (Jensen, 2006, p. 260)

Sune Jensen was critical of Sarah Thornton's (1995) adaptation of cultural capital into "subcultural capital" on the basis that it failed to properly investigate differentiation between social actors based on social class. Formulations such as 'subcultural capital' or 'gaming capital' are theoretical terms for what cultural participants would often recognize simply as 'cool'. We need to better explore how these types of capitals sit alongside more traditional forms of cultural capital, as well as social and economic capitals. A key aspect of cultural capital, in its original formation, is the centrality of the economic metaphor; cultural capital is something which is "convertible, in certain conditions, into economic capital" and something which "may be institutionalized in the form of educational qualifications" (Bourdieu, 1986, p. 248). Thomas and Apperley (2009) use Consalvo's notion of gaming capital in the context of media literacy education, allowing them to evaluate how gaming capital may sit between and alongside existing forms of capital – such as more traditional forms of literacy. For example, we could consider how different forms of gaming capital – that is, knowledge and experience pertaining to different forms of games – might be mediated by the ability to use a particular type of technology, to read in-game text and to understand cultural references within a game. They argue those researching gamers themselves should seek to understand their "accumulation and exchange of gaming capital in order to understand how it impacts on other forms of capital, rather than viewing gaming [as] a discrete entertainment oriented part time that has no meaning outside itself." (p. 7) We can relate this perspective on gaming capital to family sociologist Annette Lareau's (2011) summary of Bourdieu's contribution to understanding the reproduction of inequality:

> Overall, Bourdieu's work provides a dynamic model of structural inequality; it enables researchers to capture "moments" of cultural and social reproduction. To understand the character of these moments, researchers need to look at the contexts in which capital is situated, the efforts by individuals to activate their capital, the skill with which they do so, and the institutional response to the activation of resources. (p. 363)

Under what conditions, and in what contexts, does gaming capital become the type of cultural capital which is convertible into paid work and status? It is possible to remarry gaming capital with Bourdieu's class-oriented cultural capital by examining how particular types of gaming knowledge might relate to the socio-economic conditions of growing up and how this might, in some way, prefigure entry into new, well-paid middle-class professions? These are questions at the heart of this thesis, which has thus far argued that while there may be some cases in which gaming-related activities inculcate specific technology-related skills such as programming, these are exceptions rather than the norm.

Previous sections have considered the role of leisure in the formation of work identities, and also the ways in which PC-specific gaming may provide more opportunities for such leisure learning. Considering the existing findings about social class and gameplay practices outlined in 1.2.3 - which seem relatively consistent across both American and European studies - we might

consider that the types of gaming capital associated with obtaining computer literacy are more likely to be concentrated within middle-class gaming cultures, and more specifically among those whose parents already working in computing. Thus, a Bourdieusian approach to both games and computing helps to 'intersectionalise' the existing work on gender (1.1.1-1.14) to explain the apparent lack of interest shown by either gender in pursuing computing careers (1.1.5).

1.2.8 Summary of the Conceptual Framework

The conceptual framework put forward in the second part of this chapter has brought together various threads from within social science to emphasise the following points, which will guide the remainder of the thesis. Any loosely defined notion of 'computer literacy' can miss differences between types of computing activity. As such, it may be more helpful to speak of a plurality of computer literacies. However, we also know that forms of confidence of self-efficacy do transfer between related activities; hence why a 'computer person' may feel more confident undertaking new tasks they have never attempted before. Pierre Bourdieu's concepts can serve as a bridge between psychology and sociology, allowing us to place normally individualistic psychological concepts like "technological self-efficacy" into a broader socio-cultural context which can properly account for the relative value and uneven distribution of forms of literacy. Technology-related identities such as 'computer geek' or 'techie' should be understood as lived identities embodying the dispositions most conducive to working in the field of technology, rather than merely as cultural stereotypes which deter some potential participants.

Robert Stebbins' concept of the serious leisure career helps to describe the sense of deep identification felt by hobbyists towards their leisure pursuits; activities which may often have more in common with work than with more casual leisure forms. Sociologists following Bourdieu - such as Ellen Seiter and Annette Lareau - help to fill in the gaps in Stebbins' work by empirically illustrating how activities such as computer self-tutorage are more greatly encouraged within the homes of those already belonging to what has been described as the "technical middle-class" - a social group culturally distinct from the traditional middle-classes.

The term 'gaming' is far too broad, encompassing too wide a variety of preferences and practices to be useful in a discussion of the role of games in the gendered enculturation towards computing discussed throughout 2.1. Rather, attention should also be paid to differences in technological platforms themselves, because this is where distinctions can be drawn between those gaming experiences which are rich in potential technological learning, and those which are less so. Concentrating on the specific learning affordances of the PC as a gaming platform allows a more nuanced discussion of technological enculturation as it relates to subgroups of often male gamers, as opposed to male gamers as a whole. This in turn should help to explain why so few male gamers actually enter computing careers, if such a gaming-computing link exists at all. Given the existing body of evidence linking socio-economic privilege to PC-gaming (1.2.3) it is important to adopt a model that considers social class as a crucial mediating factor in the production of masculinities with different degrees of proximity to the prevailing ethos of established computing culture.

Chapter 2: Methodological Considerations for a Cross-Generational Biographical Inquiry

This part of the thesis describes the process by which I came to apply biographical methods to the sociological questions posed throughout the previous parts of the thesis. I attempt to offer what David Silverman (2010) refers to as a 'natural history' of the research, laying out the entire research process complete with any origins false starts and redirections. This approach to methodological writing originates from the Chicago School of Sociology and aims to provide a naturalistic account of the research process which will hopefully "explicate to the reader what is now obvious" to the researcher (ibid. p. 337). This involves discussing how personal context affected the choice of subject, as well as the reasoning behind research design choices. Before going into the specifics about how data was collected - from where and whom - I offer a personal account of the formation of the research questions. I provide a researcher positionality statement and explain the origins of some of the initial 'hunches' or informal hypotheses which informed and directed the study at its outset. I then move onto describing the data collection and the specific practicalities of interviewing the 21 adults and 20 teenaged students who made up the total sample. A discussion of the existing methodological literature pertaining to biographical research will be had in the third section of this chapter, which discusses the application of methodological theory, particularly in relation to how the interview data were interpreted.

2.1 'Whose Side Are You On?': Accounting for Positionality

2.1.1 Positioning the Researcher: Biographical Origins of the Research Topic

Most studies involve a degree of researcher subjectivity in terms of which questions are posed; how data is collected, from where and/or whom, and how answers are interpreted. The effect of researcher subjectivity is potentially more pronounced in small-scale qualitative studies - such as this - where only one researcher is involved. However, as Kirsti Malterud argues, a researcher's preconceptions "are not the same as bias, unless the researcher fails to mention them" (2001, p. 484). Writing a 'positionality statement' is, therefore, a process of bias elimination. Anthropologist Nancy Lindesfarne similarly asserts that:

> …any account must be partial and subjective … its value, at least in part, must lie in the transparency of these conditions. The exercise of writing a positionality 'section' is, therefore, to lay bare these personal biases and dispositions which do affect the research process and, by extension, its findings. (2000, pp. 151-152)

This "laying bare" is an exercise in reflexivity. Explicitly acknowledging the researcher in this way undermines what Donna Haraway (1988) terms the writerly "god trick" of adopting

a position of distant objectivity by erasing the researcher from the research process and writing in the passive. The reflexive process of positioning the researcher is one in which I am called to reflect upon my place in "grids of power relations and how that influences methods, interpretations, and knowledge production" (Sultana, 2007, p.376). Claims to total expert authority are replaced with a disclaimer that this is an account produced by a specific type of person acting in a research capacity. As such, I must be open about my own biographical background and how it came to inform the design and implementation of this research.

I came to this study with a professional background in youth work and education, and a personal history of digital gaming and hobbyist game-making. Part of my interest in the topics of study developed during my time working in a secondary school, where I was attached to a department supporting ICT and Business Studies. During this time I noticed that different groups of young people appeared to express noticeably different attitudes to games - distinctions which were more obvious or pronounced between groups of boys, who tended to be more open about gaming habits. Informal conversations which I overhead - and sometimes participated in - suggested that a large majority were fans of online, competitive shooting games. These first person shooters, typified by the Call of Duty series, were played almost exclusively on consoles, and more frequently on the Xbox 360 than on the PlayStation 3, which was slightly more expensive at the time, and less popular among this demographic. This group seemed like the target audience of much of the contemporary games industry's output insomuch as their main interests were fast-paced action, up-to-date, realistic graphics, and competitive social interaction, usually with players they knew already and socialised with in real life. Their favourite games were usually limited to a small pool of well-known action and sports franchises such as Call of Duty (2003-) FIFA (1993-) Grand Theft Auto (1997-) and Assassin's Creed (2007-). Despite not using PCs for gaming at home, many among this majority group would use school computers to play short-session web browser games during school break times - and throughout some lessons, much to the disapproval of teachers and other school staff.

In comparison, a smaller group of around ten sixth form ICT students seemed to spend a great deal of their free time at school playing PC games, most notably Warcraft 3 (2002). Warcraft 3 exemplifies a type of point-and-click strategy game (associated with the PC platform) crossed with a fantasy role playing game, whose intrinsic appeal or 'pull' (Juul, 2010, p.4) is limited to a niche of players with certain tastes and literacies. The age of the game meant it would perform well, even on the school's out-of-date machines. But the majority of this group were interested in the game regardless of its age. They circumvented school safeguards against unwanted software installation by bringing in pen-drives with the game pre-installed. Occasionally one of them would transfer files onto their school user area, allowing others to play if the owner shared their log-in password.

It was this apparent contrast that drew me in and made me begin to question some of the literature on gender, gaming and computing which I had already encountered. From my personal experience, PC gamers had usually been an insular minority with esoteric tastes; whether for the piecemeal home-construction of high-powered machines; playing obscure strategy titles or downloading emulated games from earlier consoles. As an adult now observing similar differences in a school context, what interested me most was what seemed like a relationship between the PC-gaming orientation and the study of computers. As discussed in previous chapters, much of the existing research drew connections between gaming and enthusiasm toward tech, but tended to treat digital gaming as a general field, rather than observing the different affordances of gaming platforms and the cultures that arise around each.

At the centre of this emerging inquiry was a question about the direction of causation in an observable relationship between two things. Did playing with PCs foster specific interests and/or abilities? Or, inversely, were computer interest and ability precursors - or necessary requirements - to a preference for PC games? If a causal relationship between leisure and skill did exist, was it simple and unidirectional, or did 'productive' and leisurely uses of digital technology reinforce one another in a cyclical fashion? I also wondered whether game genre preference bore some relation to broader issues of technical literacy and also to the sort of 'mindset' associated with computer programming and other related skills. Dovey and Kennedy's (Game Cultures: Computer Games as New Media, 2006) ethnography of games developers revealed shared patterns of enculturation, linking respondents' eventual careers to their earlier leisure pursuits, most notably engineering and mathematics, and table-top fantasy role-playing games such as Dungeons and Dragons. Following a similar line of inquiry, I formulated these initial research questions which intended to investigate the relationship between computing and computer games:

> Q1: What relationship (if any) exists between digital play and broader 'computer literacies'?
>
> Q2: What values do those in computing careers attribute to different types of digital play?
>
> Q3: How might differing patterns of early digital play relate to educational/work careers in technology-based areas?

These research questions stemmed from a desire to understand changing youth culture(s) and transitions into the adult world of work and, more specifically, whether gaming tastes and practices might relate to the aptitudes and aspirations relevant to the field of computing. The 2012 EU Skills Panorama report, for example, suggests that despite increasing levels of ICT training, the majority of computer-specific skills continue to be obtained informally, through peer or family tutoring, self-teaching or indirectly through hobbies such as gaming (ICF GHK/European Commission , 2012). As such, I was driven by a desire to uncover examples of this process of informal learning, and in doing so, to answer Taylor's call for games studies with renewed emphasis on the materiality of gaming platforms, the affordances of different gaming technologies, and the cultures of play and fandom that arise around each.

The methodological approach was guided by a desire to obtain biographical accounts of turning points and transitions; narratives of 'becoming' a certain type of person. While not employing the same methodology of long-term immersive ethnography, the project has its roots in studies such as Paul Willis' Learning to Labour (1977). Stanley Aronowitz suggests that Learning to Labour's important contribution was to illustrate how "schools are in constant competition for the hearts and minds of youth with powerful, oppositional cultural sites that regard schooling from an adversarial perspective" (2004, p.xiii). The present project is not as clearly focussed on socio-economically marginalised youth as Willis' work, but it does seek to identify how contemporary young people's transitions between the institutions of school and work are affected by competing cultural forces which provide alternate means of informal education and identity construction.

In addition, as I came to this research with some amount of knowledge about gaming culture, there are certain assumptions and stereotypes of PC-gaming culture which may need to

be explicated to the reader. In order to do this, relevant websites and magazines are analysed, primarily their written content. For example, the second data analysis chapter focuses on the gaming preferences and practices of some of the interviewees. However, in order to clarify widespread perceptions, the chapter begins with an introduction to PC-gaming culture which draws on information from relevant magazine-style websites and discussion boards. In the case of forum discussions - which are publically available but often conducted under assumptions of privacy - all conversation is paraphrased to preserve the anonymity of posters. These sections of the thesis took a critical discourse analysis perspective; which focussed upon the ways in which language is related to power (Fairclough, 2013) in how it is used to represent different groups of people. Critical discourse analysis sees language as something ideological which conveys or enforces the beliefs and values of the speaker. As James Gee (2004) notes, discourse conveys viewpoints which are used to mediate the distribution of social goods or status, such as insider status within a culture.

2.1.2 Positioning the Researched: Voice, Identity and Intersectionality

Biographical sociology has been associated with "giving voice" to underrepresented groups to potentially affect political change in their favour (Shantz, 2009, p.121). Howard Becker (1967) famously argued that neutrality in social inquiry was impossible, and that researchers should therefore ask themselves "whose side are you on?". In some cases, researcher attempts at reflexivity can be read as attempts to claim moral authority I this regard; "through an affinity with subjects (such as working-class woman) or through a confessional declaration of difference and relative privilege (such as white lower-middle-class man)" (Cousin, 2010, p9). Although qualitative biographical methods have been associated with lending a voice to the marginalised, I am unable to adopt similar discourses about empowerment, because I remain unsure as to whether my respondents speak entirely from positions of privilege or social exclusion. This issue relates to broader questions about 'geek' culture, and the degree to which those usually described as geeks can be categorised as marginalised or privileged in different circumstances. While 'computer geek' and 'techie' were not identities overtly claimed by all participants - particularly not among the younger interviewees – they were elective identities expressed by some of the older ones, and is used throughout the thesis as a general term for those with above-average skill and interest in computers.

In a Gender and Education article titled "Boffin and geek identities: abject or privileged?" Mendick and Francis (2012) wrestle with describing the social dynamics surrounding classification and self-classification of geekdom among young people. They argue that, although the 'geek' orientation may often be produced by a middle-class upbringing and be rewarded by the school's formal structure, such identities still invite exclusion from the wider peer group during formal schooling. As such, it is difficult to categorise geek identities as sitting either side of a privileged/excluded binary and, thus, to claim, this sort of moral positioning as a researcher working with them. At the least, I am able to say that my respondents were all willing to be heard and recorded, although many of them likely saw the things I inquired about as mundane and perhaps unworthy of scholarly attention.

The way in which real people are framed and positioned within a piece of research can also be seen as a product of the theoretical positions taken adopted by researchers due to their personal values and/or prevailing orthodoxies within their discipline(s). Writing on reflexivity, Glynis Cousin (2010, p14) suggests that researchers "in the grip of a single 'ism' (Marxism,

feminism or something similar)" can find it has structuring effect on their inquiries. Robert Burgess (1984, p. 211) similarly poses the following hypothetical: "If a functionalist, interactionist, Marxist and feminist were to be involved in studying social relations in the same factory, prison, school or hospital the questions addressed and the focus of interest would be different". This is not necessarily to suggest that -isms do not have explanatory power, but that they encourage a partial framing or a distorted image.

Even within a group which might initially appear culturally homogenous, differences quickly arise, problematizing common-sense understandings of identity as an "overly static trio of … race, class and gender" (Gee, 2001, p.99). Cousin goes on to argue that even when intersectionality is stated as a research value, the epistemological standpoints encouraged by -isms tend to mean that "sociologies of identity cleave towards an original master status" (p.17) and invite "accounts that are overdetermined by a single identity position" due to a paradigmatic concern with that dimension of identity over others (p.14).

The study presented here takes feminist investigations into culture as its starting point, but the theoretical framework explicated in the literature review (1.2) also takes social class as one primary foci - a turn many would be consider as more aligned with Marxist or neo-Marxist readings of culture. This is, of course, not to suggest that the feminist emphasis on gendered power is not of importance, but that the perspective brought by this study serves to identify nuances in how the apparent male-domination of parts of our culture might be affected by another aspect of identity. Whereas older studies of youth culture were subject to criticism for ignoring female cultural participants and reproducing the attitudes of male ones (McRobbie & Garber, 1976) feminist research which foregrounds girls and women is relatively abundant within games studies, perhaps due to the relative newness of games as a cultural form and object of academic interest. Reverting to a class emphasis is not to argue that class is more important than gender, rather that it is a better working variable to understand variations within masculinity itself.

The majority of my research participants were male – partly reflecting the makeup of the classrooms and workplaces I visited but also, perhaps, a result of my own identity and how this enabled male participants to feel more comfortable engaging with me. I did, for instance, notice that senior technical staff would speak to me as an equal; reeling off technical information including programming languages and so on without actually querying whether I understood. This may have been a product of how similar to them I appeared, but it is difficult to say without conducting similar research as part of a diverse team and seeing how researcher-identity might affect respondent disclosure. They may have had assumptions about my background knowledge due to the nature of the questions I was asking – even though I was essentially a non-programmer asking more technically-literate respondents to account for their computer use over the life-course to see if and how gaming emerged as a theme.

I did not deliberately exclude female participants from the study or put any overt emphasis on masculinity as a topic. To ask specifically for male respondents would have invited respondent accounts which, as Cousin puts it, become "overdetermined by a single identity position" (p. 14). This is to say that respondents may have been on the defensive had I explicitly asked about the politics of gender in their professional field. What I did find was that some of the women who were interviewed shared some common attitudes and biographical elements with the men (see for example the interview excerpts in 3.3 and 4.2).

The study presented here cannot make any real claim to intersectionality - most obviously because it is a study predominantly of white men undertaken by similar. It can, however, contribute to an intersectional understanding of the phenomena it attempts to describe, when read alongside the existing research described in previous chapters. The undertaking of intersectional social research is necessarily a collaborative process (Cho et al., 2013) between researchers of different backgrounds and positions. As inferred in earlier parts of the literature review (1.2.6) most of the research participants - at least the adult professionals - have already been positioned within an existing social-class heuristic as members of the "technical middle-classes". This is a way of describing their current socio-economic position in terms of the jobs they currently do, but also in several cases their class of origin – given that several had older relatives involved in technological professions.

2.2 Conducting the Interviews

2.2.1 Three Sample Groups: ICT Students, IT Professionals and PC Gaming Enthusiasts

This section begins with a broad overview of the research process itself, before moving onto individual descriptions of the three main data sets. These sets are described initially in terms of size, location, interview/visit timings and methods used, before moving onto a more detailed explanation of how the data for each group was obtained. The general demographics and sizes of each sample group are as follows;

Group 1: 18 students studying ICT in post-compulsory schooling (17 male, 1 female)

Group 2: 15 computing/IT professionals (14 male, 1 female)

Group 3: 7 PC Gamers/LAN party attendees (5 male, 2 female)

In response to some of the informal observations outlined in section 4.2, I conceived a study aimed primarily at school/college students aged 16-19 (Group 1) as well as a second group consisting of adult programmers (Group 2) four of whom worked specifically in game development and the others in more generalist IT firms. The rationale for choosing these groups was that while working with computers could be understood as a proxy for abilities in computing, choosing to study computers at a post-compulsory level could also be taken to indicate a higher-than-usual level of interest, enthusiasm and/or ability. In addition to the student interviews, teachers were also contacted toward the end of data collection and asked to offer their views on my emergent analysis. Toward the end of the data collection period, I also identified and interviewed some PC-gaming enthusiasts who were identified as working in ICT-specific professions (Group 3).

Each data collection involved only a single visit, although in a minority of cases[13] I was able to maintain sustained contact and send follow-up questions. Semi-structured interviews

[13] Respondents with whom I maintained contact following the initial data-collection period are indicated by an * in Fig. 4a and 4b.

were intended to obtain a series of 'technicity biographies' - narrative accounts of growing up with computers and becoming interested in computer careers. I used interviews to obtain a broad series of biographical snapshots from people with shared interests across different age groups and contexts (school, work, play, etc.). Following these initial observations, I would be attempting to identify whether videogame preferences among these groups held any sort of pattern. This thematic, purposive sampling produced a vertical slice of different ages which would then allow me to identify change and continuity in the phenomena being studied, particularly as it related to childhood and adolescence taking place at different historical moments and alongside different technologies. By collecting biographical accounts from different age groups I also hoped to explore differing experiences of formal ICT education and the way that the diffusion of the personal computer and internet access related to the domestic context of computer use.

Fig. 4a: Interview Participants, Locations and Durations

Cells with conjoined borders indicate interviews undertaken in pairs/groups, according to the preference of the research participants. Names with asterisks indicate interviewees who gave permission to be contacted further, and who were thus consulted after the initial phase of data collection, to contend or verify the researcher's interpretations of the data.

Interview Location	Name	Age	Gender	Ethnicity	Occupation	Duration
school A	Eli	19	m	black british	student	13 min
(common room area)	Dom	16	m	white british	student	8 min
	Harry	17	m	white british	student	10 min
	Patrick	17	m	white british	student	13min
	Yuri	18	m	White russian	student	10m
	Gary	37	m	white british	senior IT technician	19min
	Peter*	48	m	white british	ICT teacher of above students	online
school B	Ned	17	m	white british	student	10min
(corridor area)	Paul	17	m	white eastern european	student	
	Luke	17	m	white british	student	15min
	Lewis	16	m	white british	student	
	Kelly	17	f	white british	student	10min
	Craig	17	m	white british	student	
	Grant	17	m	white british	student	12min
	Luca	17	m	white british	student	
	Dmitri	17	m	white eastern european	student	24min
	Karl	17	m	white british	student	
	Jack	16	m	white british	student	10min
	Andrei	17	m	white eastern european	student	
	Jordan	17	m	white british	student	6min
	Bradley	17	m	white british	student	
	Debbie	36	f	white british	ICT teacher of above students	online

Fig. 4b: Interview Locations, Durations, and Participants (contd.)

LAN party event in a Scout hut	Danielle*	24	f	white british	data manager	21 min
	Kat	26	f	white british	educational software trainer	
	Tom	35	m	white british	IT consultant	
	Doug	40	m	white british	school network administrator	19 min
	Max*	24	m	white british	tech support engineer	23 min
	Matt	27	m	white british	computer/tech retail helpdesk	7 min
	Greg*	39	m	white british	college IT technician	online
university cafeteria	Aaron	30	m	white canadian	forensic computing student	17 min
local pub	Chael	29	m	mixed british	graphic designer	19 min
local pub	Neil*	38	m	white british	developer (contracter)	92 min
business centre (cafeteria)	David	41	m	white british	web development manager	35 min
	Ewan	27	m	white british	web developer	60 min
	Sarah	42	f	white british	web developer	
	Phillip	24	m	Chinesebritish	web developer	
	Jason	24	m	white british	web developer	14 min
	Cameron	26	m	mixed british	web developer	44 min
	Travis	43	m	white british	web designer	
games company (kitchen)	Lee	26	m	white british	games developer	22 min
	Jeremy	41	m	white british	games developer	21 min
	Mark	38	m	white british	games developer	28 min
	Nigel	26	m	white british	games developer	10 min

Group 1: ICT students ages 16-19 (see Fig. 4a)

Size: 19

Setting(s): 2 separate secondary schools. Interviews conducted in shared public areas near to students' ICT classrooms.

Method(s): Interviews (5 one-to-one interviews, 7 pair interviews). Plus some participant observation.

Time: Single-day visit. Interviews averaging 20 minutes.

Most UK schools operate a model of early specialization wherein students choose a range of subjects at Key Stage 4 (ages 14-16) either at the level of the traditional GCSE (assessed using a combination of coursework and formal exams) or more recently through vocational qualifications such as the BTEC Level 2, which are predominantly coursework-based. Students who remain in education then specialize further via A-Levels or BTEC Level 3 courses at Key Stage 5 (age 16+) usually based on their attainment in related subjects at Key Stage 4. Given that most students in Key Stage 5 take a limited number of subjects, most of which are elective, opting to study ICT at this level can be read as an indicator of enthusiasm for the subject, of higher than average ability, or as a combination of both. Focussing on this group would, therefore, allow me to explore how a group of young people's orientations toward following

careers in computer-based fields related to their leisure uses of similar technologies growing up, and to material issues such as technological access.

In both of the cases presented here I emailed the schools' subject heads of ICT about interviewing sixth form ICT or Computing students (i.e. those who had chosen the subject at a post-compulsory level). Both schools are located in Local Authority Districts within east Kent considered to have high levels of deprivation[14] and both schools cater to relatively high levels of students eligible for free school meals. The county in which the research was conducted operates a selective model of secondary schooling. However, I was unable to negotiate access to any of the more exclusive grammars or fee-paying private schools – response to my inquiries at 20 local schools was poor; a difficulty that was perhaps compounded by a distrust of outside researchers as the ICT curriculum was under particularly heavy scrutiny during this period. By focussing on post-compulsory ICT students I intended to obtain a sample of people with an interest and/or ability in computing that was higher than that of the general population (although the difficulty or inappropriateness of separating enthusiasm and ability would become a recurrent theme throughout data analysis).

> **Class A**; local secondary school (academy school). Interviews with members of a sixth form (BTEC Level 3) ICT class during lesson time, undertaken one at a time in a communal study area adjacent to the IT classrooms. 5 respondents (all male) plus informal discussion and online follow-up (during data analysis) with teacher (Peter).
>
> **Class B;** local secondary school (then technology college, now also an academy). Interviews with members of a sixth form (BTEC Level 3) ICT class during lesson time, undertaken in friendship pairs (suggested by teacher/contact) just outside of the classroom. 14 respondents (1 female, 14 male) plus informal discussion and online follow-up (during data analysis) with teacher (Debbie).

In the case of Class B, the majority of students had transitioned to sixth form after attending the school before age 16. In Class A, two out of the five interviewees had originated from the school at which they presently studied. I had previously worked at school attended by Class A, although only two of interviewees among this group were already known to me personally.

The different group sizes and overwhelming maleness reflect the makeup of both classes. The fact that only one female student was present in the total group reflects an extreme example of the male-domination of this subject area. In Class A, four out of the seven students present at the time of interviewing volunteered, whereas all of Class B chose to be interviewed (albeit in pairs; a practical consideration as I was only able to interview during the IT lesson).

Due to time restrictions associated with taking students out of allocated lesson time, interviews with members of either class tended to last between fifteen and twenty-five minutes, although they all naturally 'ran their course' rather than being cut off by time limitations. In both cases, data was collected within one single-day visit, although the teachers were contacted

[14] both schools' immediate catchment zones (in terms of Local Authority Districts) fall in the top quartile for deprivation according to the Index of Multiple Deprivation 2010 (Open Data Communities, 2014). The Index of Multiple Deprivation represents a combination of measures of local income, employment, health and disability, education skills and training, housing and services, crime and living environment.

afterward, in order to ask follow-up questions (for example, about trends I had noticed in the data and whether these were noticeable across preceding and following years of students). I was unable to maintain sustained contact with the majority of respondents due to their age and the fact that I was only able to negotiate short visits, rather than take a more long-term position as a classroom ethnographer, although in a couple of cases, students were contacted once they had left school to ask follow-up questions. These included, for example, identifying whether trends observed were representative of other cohorts of students in earlier and later years.

Group 2: ICT/computing professionals (see Fig. 4b)

Size: 14

Setting(s): Cafeteria of local business centre (office building shared by several companies). Kitchen at a local game development company. Other informal spaces (e.g. university cafeteria, local cafes etc.)

Method(s): one-to-one interviews.

Time: Single-day visits. Interviews averaging 30 minutes but some running to 90 minutes.

In addition, I conducted interviews from an older group of computing 'experts', namely those who held professional roles within software development and web design companies or other 'high end', exclusive computer-related fields. The larger portion of these interviews were conducted within a local business centre where several web and tech-related companies held offices. Respondents from this group were obtained by visiting a 'techie' meet-up group, which ran a monthly event in a local pub, where I was able to give a talk briefly outlining the aims of the research and asking for participants. From this initial inquiry, two interviews were arranged at the centre (during respondents' lunch breaks) which lead to a further five interviews by inquiring at some of the other offices. Interview times, in these contexts, were more flexible, and respondents generally had more to say, meaning that interviews ran from around twenty-thirty minutes for single interviews and up to ninety minutes (in the case when three were interviewed as a group).

The Business Centre; interviews conducted with employees of from six separate companies. These consisted of; the manager of one web development team, a junior developer from another, a two-person company (one programmer and one designer) and three members of another development team.

Although these interviews revealed some information about the sort of organisational cultures associated with tech work, the main focus of the interviews was the respondents' life histories, with the business centre's shared cafeteria providing a convenient location for interviews. In addition, four additional interviews were obtained via snowball sampling and through online solicitation using social media and employment websites. Due to its elective and non-random nature, snowball sampling is inclined to produce a sample of respondents who are particularly interested in the topic of research and thus unrepresentative of a larger group. This was less of an issue in the case of the current research, given that I was looking specifically for those with high levels of enthusiasm and emotional investment in their work.

Other Settings; total of four interviewees from various backgrounds and professions, interviewed in non-formal settings (e.g. cafes/pubs local to them). A manager of (contracted) web development teams, a graphic designer, a computer engineer who was studying a forensic computing degree, and the in-house IT technician (the last of these worked at School A and was interviewed on-site following the student interviews.) Plus an additional four members of a game development team who were interviewed in the kitchen of their workplace.

Group 3: LAN party attendees (see Fig. 4b)

Size: 7

Setting(s): LAN-party event at a public building in West Kent.

Method(s): Interviews (4 one-to-one interviews, 1 group interview with 3 respondents). Plus participant observation. Initial web-based questionnaire used to identify LAN attendees who worked in IT/computing jobs.

Time: 48 hour visit to event with informal observation and interviews averaging 20 minutes.

To follow up on some of the themes which began to emerge during the early stages of data analysis, such as game platform preferences and technological access during childhood and adolescence. I also sought out a group of adults who were particularly invested in the PC as a gaming platform. To do so, I used social media to locate an upcoming "LAN party" within travelling distance. LAN (Local Area Network) parties are gaming events, traditionally PC based (although not always) where gamers bring their machines and connect them to a local area network (LAN) in order to play games over a period of time; usually a number of days. At the local LAN party, participants pay an entry fee to help with the biannual event's upkeep. They play, socialise, eat and sleep in the allotted space, in this case a local Scouts' hut.

I constructed a short, web-based questionnaire which aimed to identify which attendees were willing to participant in the research as well as their different gaming tastes and habits and, more importantly, whether they worked in or studied ICT. I then attended the LAN party for the first 48 hours, during which time I obtained interviews with the attendees who had identified as working in tech. Although the LAN party was an interesting research site in itself, it was used primarily as a convenient place to locate people with shared interests pertinent to the research.

The Scout Hut LAN Party; total of seven interviewees (two female, five male). Three were interviewed as a group (as per their own request) whereas the others were interviewed individually. This group included two of the event's organizers. Among this group were a deputy network manager at a secondary school, an Apple Mac support engineer, a consultant for Microsoft BizTalk Servers, a data manager and a PC World tech support/customer service. This group were intended to be representative of PC gamers involved in technical professions, both software and hardware related. As such they represent extreme cases of some of the informal-learning tendencies the research sought to identify and explore.

2.2.2 Interview Structure and Questioning Rationale

Interviews were semi-structured, in that I had a series of prompts, thematic areas I asked to hear about, but respondents were allowed to talk freely, allowing for unexpected topics to arise. Although I did employ a checklist of questions as suggested by Merrill and West (2009, p. 119) I generally employed a "non-directive" questioning method "in which the interviewee is allowed to talk at length in his or her own terms" (Atkinson & Hammersley, 2007, p.101) with only a few initial prompts. However, I generally found that older or more confident respondents were happier to tell their life story with less prompts, meaning I had to employ my checklist of questions more frequently. Opening questions related to the respondents' present work or studentship (e.g. 'why did you choose to study IT?'). I then requested a personal history of interactions with computers, seeking to identify conditions of access (e.g. whether respondents had sole access to home computers) and the role of gate-keeping individuals (such as family members and/or peers).This approach concurs with a number of sources on open-ended interviewing (Burgess, 1984; Berg, 1998; Ackroyd & Hughes, 1992). In the open-ended approach:

> ...the interviewer starts with the most general possible question and hopes that this will be sufficient to enable the respondent to talk about the subject. If the respondent has difficulty … then the interviewers can move to the prompt which is more specific. (Smith, 1995, p.15)

However, given the research focus on possible links between two phenomena, precautions were taken to ensure that this link was not falsely emphasised by interviewees in ways which did not accurately represent their own experience. Because I wanted to see if respondents made any sort of conscious connection between games and their own orientation toward computers, I deliberately chose not to foreground gaming-related questions, despite their prominence in terms of what I wanted to find out. In the case of the PC gamers at the LAN party, I tended to ask them about their gaming first. In contrast, the interviews in school and work settings were structured so that games-specific questions were only asked once respondents spoke about games of their own volition. I would then ask clarifying questions about gaming preferences and habits, conditions of access to different gaming machines during childhood, and parental and peer attitudes to games. In this sense, I attempted to follow Taylor and Bogdan's advice about being "truthful but vague" (1984, p.25) with regards to divulging the research agenda to participants.

Although most interviews were conducted with only the respondent and researcher present, a minority were conducted in friendship groups of two or three. All of Class B's interviews were conducted in pairs, at the recommendation of their teacher and due to the time restraints associated with interviewing during class time. Despite some initial reservations, interviewing in friendship pairs yielded useful extra data, for example, in one case, Student A fills in Student B's omissions, pointing out that they own two consoles, when they had thus-far presented themselves as a solely PC-oriented gamer. Interviewing in friendship pairs also showed how, in some cases, friends shared very similar tastes and, in others, played wildly different games but still communicated in real-time over the same console. This is illustrated by examples of one boy playing a popular shooter while his friend played what he described as

"this weird Chinese game", all the time both of them would be communicating via headsets using Microsoft's XBox Live service. In these cases, interviewing in pairs drew attention to the social dynamics between the young people which, in many cases, highlighted differences between how the conceptualised console play as sociable and populist - "all of our mates at school have an Xbox" - and PC as having connotations of esotericism and reclusiveness. As such, pair interviewing might not have yielded the sort of 'pure' biographies initially sought, but it did provide other types of information which might have been missed otherwise.

2.2.3 Unintended Discussion and Professional Exchange with Younger Participants

Due to the open-ended style of the interviews, it was common for unexpected topics to arise. Interviewing older tech professionals at the business centre, for example, I found no significant leaning toward gaming as a hobby. In these cases, older respondents (aged 40+) provided oral histories of hobbyist routes into programming during the 1980s and early 1990s which tended to omit gaming entirely. The contrasted greatly with some of the stories of game-oriented technological acculturation presented by some of the younger students, programmers and LAN-attendees. In addition, interviewing the older respondents during their flexible lunch breaks naturally produced longer interviews than those in the school setting. This may have also been due to different levels of confidence in speaking to a researcher.

In the case of the interviews with young people, my position as "someone from the university" meant that I was occasionally asked about university life ("how much practical work is there?", "can I use my laptop in lectures? Etc." In the case of the game-development enthusiasts in Class B, I occasionally found myself pointing them in the direction of simple entry-level software they could use for free at home, and discussing my own (hobbyist) experience of using such programs. In some of the interviews it became clear to me that respondents were only really attempting to make 3D games (similar to the high-budget games they were used to playing at home) and avoiding more accessible 2D-focussed software. As someone with a background in youth work, who had previously served a pastoral role in a sixth form it was difficult not to engage in this type of exchange. At these moments, the interviews became exchanges between people with varying levels of experience, but similar levels of interest, in the process of making games. Engaging in these sorts of exchange enabled me to see a disparity between what the young respondents intended to do, and what they were able to do given the technology that was available to them at home and in school.

2.3 The Utility of Biographical Methods to Social Inquiry

2.3.1 Biography as Sociological Tool

Brian Roberts defines biographical research in sociology as research focussed on individuals, "employing autobiographical documents, interviews or other sources and presenting accounts in various forms (e.g., in terms of editing, written, visual or oral presentation, and degree of researcher's narration and reflexivity. (2002, p. 176). Biographical research is concerned not only with personal stories of individuals, but the contextualization of these accounts in broader narratives of social change. As American sociologist C. Wright Mills argued in his 1959 book The Sociological Imagination; "neither the life of an individual nor the history of a society can be understood without understanding both" (2000, p. 3). Biographical research is associated with a multi-disciplinary approach (Temple, 2006), because its research objects can be any topic which might be studied through other people's recollections. As discussed later in 2.3.4, this also requires a discussion of how exactly people recall and narrate past experience – an area of interest to sociologists and psychologists alike.

Throughout the research, the aim was to use respondents' biographical narratives to explore possible relationships between gaming and educational/work careers. Merrill and West (2009) argue that a biographical focus serves to record 'changes in how people conceptualise their past in new ways, in the light of changing presents' (p. 55) while also accounting for the performative aspects of such narration. As such, biographies provide a number of different types of data, which can all be analysed in parallel to produce a richer account. Section 2.3.4 deals more thoroughly with the variety of data gleaned from these biographical interviews, and how biographical narratives can tell us both about material concerns – such as parental careers and childhood access to technology – and also about the attitudinal and subjective dimension of people's lives. As youth sociologists Walter Heinz (2009) describes:

> A biography is not just a subjective narrative about one's life history but a time - and space-related reflection of past events, the timing of transitions, and future plans. The evolving biography reflects personal agency and is the temporary sum total of the young person's aspirations and assessments of past successes and failures and interpersonal recognition and rejection in the social arenas where autonomy and self-responsibility are expected. (p.8)

However, the biographical approach can also be criticised for its tendency to transforming its subjects into "sociology's images of who they should be" (Denzin, 1992, p.41), for example in using numerous testimonies from within a specific social group to create composite characters representing 'ideal types'. Norman Denzin (p. 44) argues that the Chicago-school sociologists tended to romanticise criminals by emphasising their agency as "reflexive biographical subjects". The biographical method, in this case, has political ramifications; overemphasising the agency of these individuals and maintaining the status quo by suggesting that they were wholly responsible for their actions. Biographical method is a micro-level investigative tool and as such it is perhaps likely to emphasis the agentic qualities of individuals over the ways their experiences and choices are structured by factors beyond their control.

> Qualitative biographical research accepts that biography of an individual can always be understood as a construct, but not only as that. The main focus of its observation lies in studying individual forms of the processing of social and milieu-specific experience. (Marotzki, 2004, p.102)

Biographical data is used throughout this thesis to test theories about cultural reproduction, with individual testimonies used to support or contest the theoretical framework outlined in previous chapters. While biographies provide unique individual accounts of subjective experience, they can also be used, as in the present case, to note some of the similarities shared across a group, in order to discuss their position in contemporary society. For example, Martine Burgos (1988) suggests that biographical narration can provide insights into how speakers position themselves in relation to other individuals or groups. Biographical investigation can illustrate how biographies themselves are constrained by wider society and culture (Shantz, 2009, p.123) whether in terms of how they are told, or the factors that go into their making. By collecting and comparing multiple biographies, we can begin to query why one group shares experiences which are largely missing from the biographies of another group.

2.3.2 Unpacking the "Insider" Researcher Ideal

The sample was made of a variety of different ages of people in different interview locations. As such, the well-noted power-differentials that can exist in interview situations (Madge et al., 1997) varied unpredictably from one interview to the next. This meant that I was traversing a number of different "field identities" (Srivastava, 2006) most of which involved me divulging some piece of information which would help to position me, to some extent, as an insider. Although interactions with the majority of participants were limited to a single visit, I took a number of things into consideration in order to allow interviews to run smoothly. I was relatively open about my own biography, as a researcher, as a gamer, and as someone identifying with videogame and 'geek' culture more generally.

Ann Oakley (1981) argues that biographical interviewers should offer information about themselves in order to build trust and connection. However, insider knowledge is not necessarily beneficial in its own right, and can raise further issues (Srivastava, 2006; Ganga & Scott, 2006). Reflecting on their own work with migrant communities, Ganga and Scott (2006, para. 1) argue that being insiders "...affords the researcher a degree of social proximity that, paradoxically, increases awareness amongst both researcher and participant of the social divisions that exist between them". An insider researcher may be more aware of social divisions between themselves and the participant, and within the communities participants belong to.

The research - as is the case with the vast majority of research occurring under the games studies umbrella - incorporates the 'insider research' perspective outlined by Paul Hodkinson, in which the researcher is also an enthusiast in the topic of research (2005, p.136). Hodkinson notes that such a relationship enables trust, allowing interviews to move toward a 'two-way exchange rather than the usual question-and-answer format' (p. 139). One may enter a group to study it while already identifying as a member, as in Paul Hodkinson's study of the goth subculture (2002) but may face the difficulty of being perceived as inauthentic/uncool and therefore unable to fully participate while observing (Thornton, 1995; Muggleton, 2000; Hodkinson, 2002). In some cases, the researcher can make themselves appear to be a cultural

insider through deception, as with the covert observation of groups which are potential dangerous, or secretive due to criminality or deviance from societal norms (Humphreys, 1970; Fielding, 1982). As Hodkinson (2005, p. 137) suggests, trust between researcher and participant can be damaged by attempts to construct "what may be construed as an artificial façade", and in some cases it is better to openly present as an outsider "where inflexible indicators of age, class or ethnicity may be liable to undermine attempts at participation."

This problem is particularly pronounced when, as in the present study, participants came from a variety of different demographic groups and were not bound together by community or locale. Therefore, I attempted to be relatively transparent about my own knowledge throughout the interviewing process. For example, when discussing a technological object or a related activity, I would often offer examples of my own experience or preference. In the case of the adult professionals, this often entailed discussions of the role played by 'hand me down' computers during my own childhood, which in some ways mirrored their own experiences of inheriting machines from old siblings or other family members. In many of the discussions about games, this exchange would relate to personal gaming histories and preferences. There were also situations where respondents described aspects of hardware or software that I was not familiar with, sometimes in ways which suggested that they had assumed I had prior knowledge. In these cases it was necessary to admit to the lack of knowledge in order to prevent misunderstandings occurring mid-interview.

In the case of many of the gamers, I felt it was important to position myself as a 'games positive' researcher, given that gaming is still a contested practice with some adults seeing it as a waste of time or even potentially harmful (Thornham, 2014). The controversies surrounding videogame content are already well-documented, and are relevant here only insomuch as they affected my approach to interviewing those who identified as gamers. As noted by Ferguson and Dyck (2012) most of the evidence base for popular fears about videogames and aggression tends to derive from studies in behaviouralist psychology which are funded by lobby-groups of concerned parents in the US. Although gaming is a relatively widespread hobby for young people, games remain controversial among older and/or more conservative sections of UK society. The Daily Mail newspaper, for example, continues to publish articles critical of videogames as morally corrupting (2013) or linked to poor behaviour, aggression and hyperactivity (2015). I felt conscious that some respondents might feel defensive of their hobby, which could lead to them producing accounts which either underplayed the frequency of their gaming, or, conversely, leant toward 'defending' gaming by overtly emphasising some educational or social aspect. As a result, it was necessary to express some degree of enthusiasm toward the hobby, where appropriate, in order to elicit responses which were not overly guarded.

As other researchers have noted, in line with the insider research tradition, having played the same games as participants is "a crucial aspect of building rapport with participants" (DeVane and Squire, 2008, p. 270) allowing researchers to ask "informed questions about the heterogeneity and complexity of participation and play in game worlds." (Walsh & Apperley, 2008, p. 101). For example, DeVane and Squire's research around Grand Theft Auto: San Andreas (2004) found very different readings of the game from young American players of different ethnic and class backgrounds. Such player-focussed studies contrast starkly with textually-focussed research into the same game, much of which tended to put forth a single, expert reading which saw the game and those like it as implicitly racist and socially harmful (Leonard, 2007; Barrett, 2006). The latter form of research may provide useful readings which

counter misguided public perceptions, but in this case it is ultimately the meanings attributed to games and devices by research participants which is of methodological relevance.

Insider status allows a greater appreciation of the more subtle differences between researcher and participant and between participants themselves (Ganga & Scott, 2006) revealing things which might be invisible to a non-gamer researcher. However, Glynis Cousin argues that an unreflexive 'insider' researcher also runs the risk of "inviting accounts that are overdetermined by a single identity position" (Cousin, 2010, p. 14). For example, asking women questions about their experiences of gaming and the surrounding culture will inevitably yield different responses depending on how the interviewer positions them as adult gamers, female gamers, white gamers, and so on, through the questions asked.

While I did not have experience with every game that was discussed, I was able to identify when different participants talked about the same game in different ways. Despite the importance of this kind of exchange for rapport and trust building, it would also harm the sense of trust if respondents were to feel as though they were being judged for their tastes, so I tended to only show my own interest in specific styles or genres of games once a similar interest was already shown by the participants. It was practically impossible for me to share all or even most of the gaming experiences shared by some of the participants: The idea of the 'insider researcher' is only of limited applicability here, given the heterogeneity of gamers' cultures and the impossibility of an individual occupying all of them. Indeed, one of the aims of this thesis has been to work against impulses to discuss 'videogame culture' as if it were a homogenous sphere populated by socially similar agents.

2.3.4 The Role of Memory in Biographical Narration: a Psycho-Social Approach

Given the study's reliance on participants' memories, it was necessary to consider how memory has been theorized and studied within different disciplines. In the constructivist sociological perspective on memory, recall is viewed as the product of narration. Middleton and Edwards (1990) argue that speaking about the past serves to structure concepts like "memory" and "mind" - rhetorical stand-ins for psychological operations which are otherwise unknown to individuals. According to Paolo Jedlowski (2001) the sociology of memory has taken a number of different foci, including the social aspects of individual memory, collective memories and cultural attitudes towards memory. The psychology of memory has a more individualistic focus, which is perhaps more appropriate when considering accounts given by different individuals who are not necessarily part of the same community.

While verbal accounts can be considered "performative" (Borland, 1991; DeVane & Squire, 2008; Jenson & de Castell, 2008) psychological perspectives also suggest that the phenomenon understood as "selective memory" is particularly relevant to learning experiences. Through a meta-analysis of psychological research into memory, Conway and Pleydell-Pearce (2000) put forward the "Self-Memory System" (SMS) a model in which stored and recalled memories are closely related to the individual's conception of self. This is what would be referred to as 'selective memory' in everyday terms, but in this model, the selection of memories is something which occurs unconsciously in accordance to the individuals present-moment definition of self. One observation from this body of literature which is particularly pertinent to the current study (given its focus on informal and incidental learning) is that the

most salient memories recounted around an activity tend to be those related to learning. For example, John Robinson (1992) collected "mini-histories" for first time experiences such as early romantic courtship and learning to drive a car. As Conway and Pleydell-Pearce summarise;

> [Robinson's] initial findings suggested that these were organized around individual memories representing events featuring goal-attainment knowledge (both positive and negative) that appeared to convey significant information for the self (e.g., about how easily a skill was acquired and about success and failure in intimate interpersonal relations). Interestingly, both types of minihistory featured highly vivid memories for critical moments of goal attainment. Virtually all of Robinson's (1992) participants had vivid memories for the first time they drove a car alone and for a first kiss. Indeed, Robinson proposed that these first-time memories were a particularly important category of general event and served to determine the nature of the self. (ibid. p. 262)

Pride at success and shame at failure are thus identified as powerful emotions located around very specific learning events in biographical narratives. To offer one pertinent example from my own data - an interview in which learning about hardware was discussed - one participant described how he had felt "chuffed to bits" about having saved up for, and assembled, a high-end gaming computer. This expression of pride contrasts strongly with another account, where a different participant describes having cried after thinking he had "killed" his Amiga computer attempting "hardware hacks to increase the memory, using a Stanley knife" - an expression of shame/regret.

The understanding of autobiographical memory offered by psychology is, therefore, of great relevance to this study. Incorporating this understanding of biographical memory allows us to bypass the methodological criticism that respondents may be offering a highly selective account, by illustrating how memory selectivity is closely related to the process of learning. The strong emotions which cause a memory to stand out most vividly should not be regarded as a tainting influence on an otherwise objective account of the learning process, but as something central to it. Here it is possible to see parallels with sociological perspectives on memory, one of which is that "the factual truth of what the individual claims is less important than its emotional truth" (Jedlowski, 2001, pp.31-32). The "emotional truth" of biographical claims is of great relevance to a study which is ultimately about affiliation; the ways in which particular types of people achieve and enjoy a 'cultural fit' with an existing field.

Conway and Pleydell-Pearce present a body of literature which illustrates how memory is related to the "working self"; the self which comprises a structure of goals and attempts to affect change in the world. Here, the working self is shown to determine which events are recalled or omitted during biographical interviews. For example, those with strong leanings towards independence or dependence show strong leanings toward recalling memories which fit with that view of themselves (Woike et al., 1999; Markus, 1977). Woike et al. (1999) illustrated how those with strongly individualistic or agentic personality types tended to recall emotional events related to issues of agency (such as feeling masterful or humiliated, as in the examples given in the previous paragraph) while more communally-oriented types "recalled emotions and memories featuring others... in acts of love and friendship" (Conway and Pleydell-Pearce, p. 267). Dan McAdams (1982) similarly identifies that dominant types of individual motives affect biases in the availability of different types of memories, suggesting that "the goal structure of

the working self makes highly available those aspects of the knowledge base that relate most directly to current goals" (Conway & Pleydell-Pearce, 2000, p.267). In other terms, the phenomena referred to in lay-terms as 'selective memory' should not be regarded as an act of duplicitousness; it is often unconscious, and central to how individuals express their subjective experience.

This understanding of individuals' motivating senses of self is not simply an exercise in classificatory psychological analysis. Rather, this aspect of individual psychology has genuine sociological consequences in terms of the degree of agency felt and enacted by those individuals. For example, in one psychological study of people from socially and economically deprived backgrounds, Csikszentmihalkyi and Beattie (1979) found that those who managed to obtain higher status occupations did so through a conceptualization of the problem of poverty as a result of social injustice (rather than as a simple lack of money). The problem of poverty was thus dealt with in a different (and apparently more effective) way, in accordance with how these individuals had conceptualised it, based on memories related to "life themes" such as social injustice. For these reasons, it may be unhelpful to artificially separate out the psychological and social dimensions of human experience, even if this means working across academic disciplines which are sometimes at odds – as was the case in the dialogue between Sherry Turkle and Judy Wajcman cited in 1.1.3.

2.3.4 Lenses and Limitations: Analytical Approaches to Biographical Interview Data

The approach taken to the analysis of the data collected is an important part of the overall methodology, informing the analytical accounts offered throughout the following chapters. Following the initial data collection, audio-recordings of interviews were transcribed verbatim. These were then read several times until initial themes emerged, primarily around spatial or temporal specificities e.g. work, school, childhood, adolescence etc. Specific activities – such as owning particular technologies, playing particular types of games or engaging in game-related computer programming – were also group, and threads were drawn between these and the major categories. To take one example from the latter analysis chapter, section 4.2 draws comparisons between the types of computing activities undertaken by research participants at school and their attitudes to work. In 4.2, I characterise 'techies' as somewhat rebellious, in terms of how they used computers in educational settings and later in life at their workplaces. This type of analysis stems from identifying similar sub-themes in narrative-fragments taken from different points in the biography. For example, some respondents reported trying to use school computers in unsanctioned ways, while later recounting forms of workplace resistance such as hiding irreverent messages in code.

Questions of analytical approach also include addressing the stance taken on what constitutes data. Bridget Byrne (1998) describes two dominant ways of conceptualizing interview data; either as a resource or topic. Data treated as resource is seen as "reflecting the interviewees' reality outside the interview" whereas data treated as topic is seen as "reflecting a reality jointly constructed by the interviewee and interviewer" (Rapley, 2001, p.304). Timothy Rapley emphasises the importance of the second approach in attending to the interactional focus of the interview, arguing that the co-constructedness of interview accounts is often downplayed by researchers writing themselves out of the data presented in reports. When the interview is a

topic in itself, researchers may also focus on issues of performance (see 5.4) including the way that interviewee's "accounts" or "versions" position them as moral actors (Cuff, 1993). The view of interviews as topics sees respondents' accounts as performative constructions of a sort of internal reality; as a window onto sets of values. The interviews-as-resource perspective is aligned with an interpretivist epistemological position. In contrast, the interviews-as-resource perspective sees interviewees as a source of factual/false information about actual events and is thus more closely aligned with positivism. As Hester and Francis (1994, p. 676) note, positivists are inclined to view the "interactional character of interviews" as a "technical methodological problem" - something which undermines the reliability of data gathered this way. A tension between these two competing epistemologies is no doubt present throughout this study, as positivist inquiries into respondents' life histories vie for attention with interpretivist analyses of the way views and beliefs are expressed.

Although I intended to take respondents' biographical accounts as informative oral histories, I also became aware of how the interview design might generate accounts that were performative. Interview data can represent both an account of the respondent's subjective experience and also a performance to interviewer and any other audience (Borland, 1991). These concerns echo those of existing researchers in the field, who warn against taking participants' expressions of taste at face value, especially when influential peers are present. For example, Diane Carr's (2005) work with girls at a single-sex British school found that what respondents expressed a preference for tended to be very dependent on peer tastes, and formed by conditions of access at home. For Jenson and de Castell (2008) generalized questions about gameplay habits led to confusion as to whether the types of games played by girls "counted", and this suggested a perception of hierarchy between "proper" games played by boys and the more casual games the young female respondents played. Jenson and de Castell thus argue that "what we have are not informative answers to our questions, but informative performances of gender-normativity" (2008, p.21). DeVane and Squire's (2008) work with American boys from different ethnic and class backgrounds similarly found that respondents gave different reasons for liking the same game depending on whether they were disclosing to peers or researchers. Such observations remind us that the performative, positioning nature of taste statements should always be considered, and that qualitative work that simply relays participants' own words can veer close to essentialising social groups by attempting to extrapolate what they 'really want' rather than, for example, interpreting how their expressions of desire might illustrate the constraints put on them as individuals and as members of visible social groups.

The stance taken on what exactly constitutes data is relevant in terms of what sort of questions we are able to answer, as well as the position taken in relation to the research participants themselves. The two perspectives on interviews outlined above provide two separate and sometimes conflicting analytical lenses to be applied throughout the course of data analysis. The lens, as a filter through which a phenomenon is viewed, provides a metaphor for ways of interpreting data. Analytical lenses provide the researcher with different "analytical tools deriving from distinct theoretical perspectives" (Taber, 2008, p.70) such as positivism or interpretivism. A single analytical lens would provide an inadequate account of the research undertaken, because biographically-focussed interviews provided two main types of data: those pertaining to material conditions and events, and those pertaining to attitudes. Each of these types of data can be analysed concurrently, but they require the application of different analytical lenses. The Bourdieusian theoretical framework laid out in the second half of Chapter 1 sees these two aspects are inseparable, insomuch as subjective dispositions – habitus – are viewed as products of social positions which are often related to material considerations such as financial wealth. The researcher is required to take the respondent's word about the material

'truth' of their accounts, while also paying attention to the expressions of attitudes and values which indicate the subjectivity through which material 'truths' are narrated.

The 'materialist lens' treats interviews primarily as a resource; as oral histories relating to themes such as the state of formal ICT education in England at different historical points, as well as different individual's access to types of technology. The materialist lens is a methodological metaphor for a mode of analysis which focussed primarily upon the 'facts' which can be drawn from interviews, which are viewed as resources. These 'facts' include the availability of specific technologies at specific times and the presence and influence of gatekeeping or inspirational adults or peers. Using this perspective, the researcher is interested in events described by the interview - but usually external to it - and concerned primarily with what respondents have/had, know/knew and do/did.

In comparison, the 'attitudinal lens' describes an analytical focus which takes speakers' values and beliefs as its 'facts'. Data falling into this category include IT professionals' ideas about the 'programmerly mind' and its origins, or gamers' views about their own identity or the superiority of one device over another. Interview data are also laden with judgements of taste and of values. Focussing on this data means viewing interviews as a topic of research in their own right. Here, a second, attitudinally-focussed analytic lens was employed. This lens is concerned with what respondents think and believe and coincidentally, how these thoughts and beliefs might affect how they narrate life events and present their current beliefs. The attitudinal lens treats respondents' biographies as performative expressions of identity. In the case of this study, this analytical focus helps us to analyse respondents' tastes; their experiences of leisure in terms of gaming and computing, and their subjective identifications with their careers of work and/or study.

Neither the attitudinal nor materialist perspective provides a complete picture, because material conditions shape subjectivity[15]. As Jens O. Zinn explains; "for some [biographical] researchers the central aim of research is to produce rich descriptions (of persons) whereas others aim to conceptualise structural types (action logics or how persons and structures are interlinked)." (2004, p. 3) In the case of this thesis, the aim is the latter; where "action logics" refers to how people rationalize their choices and behaviours under specific conditions. For example, we may consider how an individual chooses to enter a post-compulsory computer science course at age 16, and how this relates to structural issues such as local educational provision and the technologies they have access to in the home. Keith Taber (2008, p. 70) thus argues that "analytical pluralism" (the application of two or more analytical lenses) is "justified where each theoretical perspective only provides a partial picture of the process being studied and where the distinct perspectives may be considered to be congruous". It is necessary to take an approach which can adequately obtain 'insider' perspectives on people's lives, while also considering these as emerging from specific material contexts linked to social structure; for example by taking into account household income and parental technological proficiency rather than viewing a young person's account as separate from such considerations.

Research which attempts to understand the subjective experience of participants is described by anthropologists as taking an 'emic' perspective, whereas research which "echoes the outsiders' or researchers point of view" can be described as 'etic' (Madden, 2011, p.19). Tackling the research questions naturally meant shifting between these two approaches

[15] As suggested in the discussion of cultural reproduction in Chapter 3

throughout the research in order to understand the interplay of two types of data; attitudinal and materialist. For example, what (if any) connections could be drawn between owning a computer from a relatively young age (materialist) and relating to computers in a specific ways (attitudinal)? How do conditions of access (materialist) relate to the adoption of a "geek" subjectivity (attitudinal) and to the possibility of a career in ICT-related fields (materialist)?

When an emic approach is taken, interviews are treated as windows onto respondents' subjective experience of the world. Shifting to an etic approach means the researcher becomes an interpreter. This is a necessary shift toward interpretivism, because "human beings have agency, and are often disinclined to see themselves exclusively through a vulgar sociological lens" (Cousin, 2010, p. 14). A solely emic approach is sufficient for asking questions such as "what are the beliefs and values of this group?" but to suffix the same question with "… and where do they come from?" necessitates a shift to a more etic approach in which the researcher draws together the beliefs of the researched and observations of their own (often drawing on existing research in the process).

Conversely, had I only been interested in how a computing-orientation might relate to historical conditions of access, a quantitative survey comparing students of computing-related and unrelated disciplines would have sufficed and would have operated from a purely etic approach. However, I am working from the assumption that technical skill (and the acquisition of such skill) is closely related to enthusiasm; a strongly subjective dimension which needs to be understood firstly through the respondent's own voice before being subject to outside analysis. Thus, we can consider how the research questions are related to these contrasting (but not mutually exclusive) analytical positions;

Q1: What relationship (if any) exists betwe*en digital play and broader 'computer literacy'?* (a question requiring an etic approach, which requires us to adopt a view of participants' biographies primarily as factual accounts)

Q2: What values do those in computing careers attribute to different types of digital play? (a question requiring an emic approach, which might serve to illuminate some of the issues arising from the first question)

Q3: How do differing patterns of early digital play relate to educational/work careers in technology-based areas? (the third question combines themes from the first two and more directly addresses relationships between informal leisure and formal careers, or "how geeks get geek jobs", to rephrase Paul Willis (1977) Learning to Labor: How Working Class Kids Get Working Class Jobs.)

The materialist lens was particularly dominant during early stages of data analysis which occurred parallel to data collection. At this stage, I was primarily interested in how computer literacy might relate to material conditions of access, including what type of machines people grew up playing or "tinkering" with. Here, the first question loomed largest. I was interested in the possibility of a causal link, and, therefore, working on a positivist model of hypothesis-testing which the qualitative biographical method was not capable of fulfilling. Following transcription of the interviews, during the mid-stages of data analysis I became increasingly interested in more qualitative issues emanating from the second question. For example, I had started to note the extent to which consoles and computers were or were not consciously linked in respondents' accounts. In this case, interviews were treated as windows

onto respondents' subjectivities, revealing how they ordered and made sense of their own life histories and career trajectories alongside technology. In short, the second of the above questions yielded the most fruitful answers given the method applied. These answers - revolving primarily around subjective understandings of gaming and computing – can help to produce tentative speculations upon the first and third questions, but not true 'answers' in any broadly-generalizable sense.

2.4 Summary of the Methodology

There is some scepticism toward biographical methods; most notably a belief that biographical researchers are unable to comment upon broader socio-cultural questions due to an atomizing focus on individual lives. Being purposive in my sampling has allowed me to take a group of participants from similar professional and/or educational backgrounds - most of whom do not know each-other – and look for similarities and differences in their experiences and attitudes. Doing so has also allowed me to position these specific biographies within a broader historical narrative about technology and its users, established through available secondary accounts about the history of computing, gaming and education in the UK.

Biographical interviews are both a resource for the collection of data about life events, and also a topic of research in themselves; insomuch as these performed narratives reveal subjective attitudes and worldviews. I take the position that biographical interviews should be viewed as both a resource and topic, precisely because the material and subjective dimensions are fundamentally interlinked. Bourdieu's metaphor of Habitus – introduced in Chapter 1 - describes how people's worldviews and dispositions are the product of material conditions, while also having the frequent effect of reproducing these conditions – for example in constraining young people's educational and subsequent career options so that generations of the same family remain in similar types of work. As such, biographical interviewing is not a choice between 'interview as resource' and 'interview as topic'. Due to a focus on early years, both types of data are interconnected in ways which should not be ignored.

Understanding the practicalities of the interview process itself includes a consideration of the fact that interviews were conducted with differently-aged groups of people in different types of settings. Most notably, the young people were more likely to want to be interviewed in friendship pairs, and to give generally shorter answers and to talk less about their earliest years. My questioning rationale way built around the notion of building and maintaining trust through self-disclosure by the research, while attempting to remain 'truthful but vague' enough to avoid encouraging false disclosures of perceived connections between gaming and IT where respondents had themselves not previously perceived such a link.

While I have attempted to account for my own positionality in the research, I cannot appropriately answer Becker's (1967) question of whose 'side' I have taken. As indicated by the stance already taken throughout the literature presented, I take the position that those in technical families are often the product of some form of socio-economic privilege, but this is not to say that they are necessarily aware of this or defensive of it any conscious, explicit way. This section also outlined the stringent anonymising processes taken toward data gathered from online sources, which were necessary to include in order to provide background context, for example in the discussion of PC-gaming culture in 3.3.1-3.3.2.

My own biography exerts a degree of influence over the research at every stage; from the formation of questions and the choice of sites, to the selection of methodologies and theories, and the analysis of data collected. Most researchers associated with games studies are themselves players of games, with their own tastes and preferences, and my professional history of working with teenagers put me in a unique position to observe how school cultures intersected with gaming cultures. There are advantages and pitfalls of being an 'insider' in researching lived experience, and also the difficulty with making such a distinction; I am a 'gamer' but not necessarily in the same ways as every gamer I spoke with. I was a professional outsider to most of the adult respondents, and younger than many of them, while also being a cultural insider in terms of some shared experiences of hobbyist programming. Insider status is never fully achieved and can change depending on the setting and the topic of conversation. I question the homogenising assumptions about social groups (like 'gamer' or 'techie') that notions of 'inside' and 'outside' tend to reify. One of the ongoing challenges for studies of what is often referred to as 'videogame culture' should be to challenge characterisation of games as a relatively homogenous cultural field (Shaw, 2010). Rather, there are a multitude of videogaming cultures, and individuals may be insiders or outsiders in any number of these.

Chapter 3: The Player and the Platform; the Role of PC Gaming in the Learning Biographies of IT Workers

The following chapter takes a platform-focussed perspective to explore changing relationships between computing and gaming since the 1980s. One position taken throughout this thesis is that player identities are inextricably bound up with preferred technological platforms. Relationships between players and platforms - described earlier through the interrelated metaphors of technicity and habitus - are crucial to understanding the historical connections between gender and broader techno-culture suggested by existing literature. While a special relationship between a young person and their computer may grant some hidden benefits, the majority of people do not share such a relationship to their gaming machines, instead viewing mobiles, laptops and consoles as objects of casual leisure associated with communication, competition, escapism and time-passing. The focus of this first block of data analysis centres upon the specific values attributed to youthful gaming and related activities in the accounts of adults who are now in IT careers. In order to do this, the chapter is structured as to move back-and-forth between broader descriptions of context drawn from literature and the subjective accounts of the interviewees.

Although some of the technical specifics of the personal computer were discussed in the literature review (1.2.3) that discussion is expanded here, to illustrate similarities and discrepancies between existing accounts and those provided by the research participants. If "neither the life of an individual nor the history of a society can be understood without understanding both" (Mills, 2000, p. 3) then it is important to understand participants' accounts as grounded in particular contexts of national identity, educational policy and conditions of technological availability. The last third of the chapter also includes a short discourse analysis of post-millennial online gaming culture (3.3.1) which is necessary as it illuminates some of the interview data discussed in the closing sections.

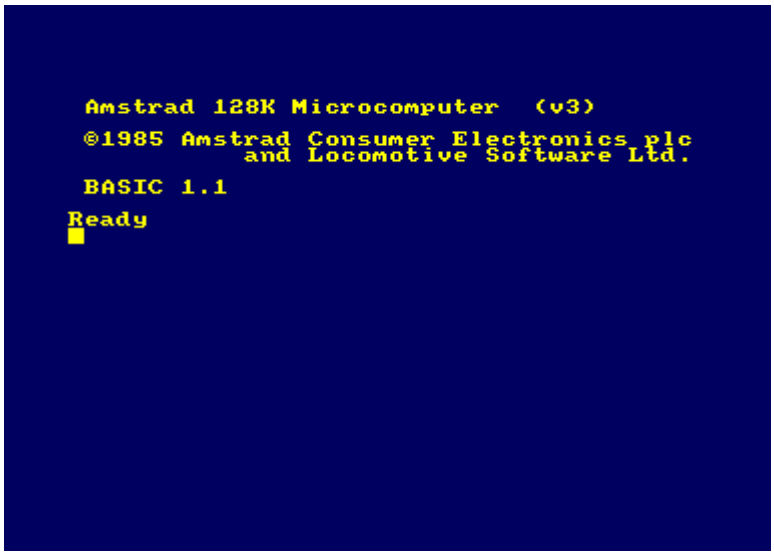
3.1 Microcomputers in 1980s Britain: Context and Use

3.1.1 Tool or Toy? Competing Perception of Early Home Computers

At the start of the 1980s, the availability of relatively inexpensive computers meant that some British youth could begin to program at home, having previously been dependent on schools and clubs for computer access in the 1970s (Kafai, 1995; Wells, 2014). The majority of these machines came with a built-in programming language called BASIC (Fig. 5) which mimics natural English, making it suitable for beginners hoping to create games and other programs. Game-making in BASIC played an important role in early hobbyist computing. For example,

David Ahl (1975)– an employee of hardware manufacturer DEC and founder of Creative Computing magazine in 1974 – published a book of 101 BASIC Computer Games as early as 1975. BASIC was an entry-point for beginner programmers, but programs written in it ran much more slowly than those written directly in machine code - most games and software of the era were not written in BASIC but in assembler; a language less similar to natural English and more akin to machine code. As well as programming, users could load software (such as games or educational software) from tape cassettes or floppy drives. Floppies were more expensive and therefore rarer. Earlier machines, like the Sinclair ZX80 (1980) had to be assembled from kits, or could be pre-assembled for an additional cost. This made these machines especially popular among people who had already been electronics hobbyists - although only one of the IT workers interviewed for this thesis had ever owned one of the "build-you-own" style micros from the early 1980s. The earliest machines also lacked storage devices, meaning that programs had to be inputted newly each time the user wished to run them, whereas by the mid 1980s it was possible for most micro-users to save programs to cassette tapes or (more rarely, due to their price) floppy disks.

Fig. 5: public domain image of an Amstrad CPC screen running BASIC (taken from Wikipedia)



Microcomputers were still, however, largely the preserve of those with money and an existing interest in programming or electronics. The 1980s was a decade of financial recession and a widening income gap, and the number of British workers earning less than half the national average wage would double from 1981 to 1991 (Pitts, 2007, p.279). Average annual earnings for British workers are estimated at around £5,820 during the period between the release of the BBC Micro in 1981 and the Amstrad CPC in 1984 (Clark, 2014). A new microcomputer costing around £300[16] would have set an adult back by over half a month's

[16] The 1981 BBC Micro cost £235-335 with prices later increasing to £299-399 (Kelion, 2012). The Commodore VIC-20 was released in 1981 at around £299 while it's successor the Commodore 64 cost £399 to buy new in 1982 (pcmuseum.ca, 2014). The 1984 Amstrad CPC cost between £199 and 299 (retrogamer.net, 2014). The much cheaper ZX Spectrum released in 1982 originally cost £125-175 (Kelion, 2012) with prices later dropping to £99-129. The ZX81 (the 1981 Spectrum's predecessor) retailed at £49.95 as a kit or £69.95 assembled (Hyphens indicate price differentiation between two models sold concurrently.)

earnings, making home computers the preserve of the well-salaried and their children. Computer purchases were also made mainly by men, who were more likely to have a personal "slush fund" to spend on such luxuries (Deem, 1986; Haddon, 1990). While some of the older research participants obtained their first computers as gifts or salvaged from family members' workplaces, the majority of early-adopting households would have been those with higher incomes.

The microcomputers of the 1980s did vary in price, and sales statistics reflect this. British computer magazine Personal Computer News reported the popularity of different machines for the second part of 1983, with the relatively cheap ZX Spectrum a consistent favourite among the British public (Smith, 2013). The BBC Micro was, in contrast, well-known and popular due to its presence in schools across the country, but was too expensive for most home users. The BBC Micro retailed at £235 (for the cheaper variant) on release in 1981, compared to Sinclair's ZX Spectrum, which retailed at £125 one year later. By the mid-1980s, these machines would retail for £299 and £99 respectively, as BBC and Sinclair moved to occupy opposite ends of the market. Although the cheaper machines were among the most popular, these would have remained prohibitively expensive for many consumers. The respondent accounts offered here, therefore, represent the experiences of a niche group of early-adopters. Those I interviewed who were old enough to have been active during this period owned a variety of machines, but because BASIC was included on all of them, they all offered similar opportunities for learning to program.

In 1984, the Financial Times reported that an estimated 10% of British households owned a computer (Crisp, 1984). This is small compared to the predicted 75% figure in 2010 (Shepherd, 2010). While the validity of such statistics is open to contestation, taken together these figures provide a sense of the comparative rarity of computers in the 1980s. The way uptake rates are spoken about during the two periods also give a sense of shifting societal ideas about computers. In more recent years – and with the advent of the Internet - public discourse has become oriented around the conception of the computer as a necessity, with the E-Learning Foundation report cited by Shepherd relaying concerns about potential disadvantages for the minority of Britons unable or unwilling to purchase a computer. In contrast, the Financial Times reported the 10% ownership rate as a surprisingly high number in 1984, indicative of the rising popularity of the computer as a luxury consumer product, and challenging one popular perception of the machine as a curiosity or short-lived fad.

Computers were beginning to become household items in Britain during the 1980s, but popular opinion was divided upon whether they existed primarily for pleasure or for the more "serious" ends of education and work. Home computer uptake was partly accelerated by interventions from media institutions and the political establishment. In 1982, the BBC launched a nationwide computer literacy project, broadcasting a series of instructional television programmes alongside the roll-out of the Acorn-manufactured BBC Micro in schools (Sakeld, 1982). It is during this period that the idea of computer literacy as a basic requirement of civil engagement begins to emerge. For example, a 1981 Department for Education strategy document talks about a need to prepare children for "life in a society in which devices and systems based on microelectronics are commonplace and pervasive…" (DES, 1981). School pupils' computer literacy was made a cause for concern in relation to the UK's global economic position, with Margaret Thatcher asserting that Britain needed to be "one step ahead of other countries" in this regard, during a 1982 Department of Trade and Industry address (Mackay, 1992, p.129).

The British educational system was thus charged with ensuring the country's ability to compete with other nations in the production of high-tech products such as computer software (McNeil, 1991, p.133). Neil Selwyn (2010) argues that the Thatcher government and the UK IT industry colluded to create an economically and politically driven concept of "educational computing" which persists today. For example, British Telecom's investment in school Internet connections during the late 1990s was arguably a way of feeding demand for their service (Bromley, 1998) both in terms of establishing their products and services within schools themselves, and with producing a generation of young-people who would desire internet connections at home. The deployment of technological products and services in educational settings is always entangled with business, throwing doubts upon any characterisation of educational computing as a wholly altruistic endeavor. Critics like Selwyn see educational computing as an ideology which foregrounds the benefits of computers to children, but which is fundamentally driven by the commercial interests of the IT industry, alongside governmental pressures to alleviate structural unemployment.

Fig. 6: Magazine advertisement for the Dragon 32 micro

The emphasis on educational computing emanating from the BBC and government was mirrored in the sales rhetoric used by manufacturers themselves. One magazine advert for the 1982 Dragon 32 micro (Fig. 6) aptly illustrates some of the tensions around home computers at the time, most notably the embedded sexist premise that the presumed reader's wife will know little of computers and need to be convinced of their merit. The advert goes on to assuage concerns about the machine by assuring parents that their children will "learn as they play", and highlighting the cost-effectiveness of a machine which can be used for writing, art and programming. It also attempts to position the machine as more cost-effective and wholesome than standalone handheld games or "those Space Invader machines"; games consoles which could not be programmed.

Early claims about the educational value of microcomputers were not, however, met without skepticism at the time. Writing about the Sinclair company, Adamson and Kennedy (1986, p.121) argue that the producers of micros were disingenuous, and had exaggerated the educational value of their products in order to exploit middle-class parents' desire to give their children what seemed like an educational advantage. One view was that "educational" sales rhetoric duped parents into buying microcomputers which were - in reality - used primarily for gameplay (Adamson & and Kennedy, 1986; Murdock et al., 1992). Adamson and Kennedy (p.322) attribute the rise in home computer sales in the first part of the decade to the proliferation of new game software, taking the position that the uptake of micros for purposes of home education was misguided, and that gaming and programming were mutually exclusive activities.

> Although in the end most home microcomputers were exclusively applied to running arcade games, they were nevertheless regarded as inherently educational. Predictably, this misapprehension was milked for all it was worth by the manufacturers. (ibid. p. 313, emphasis added)

Murdock et al. (1992, p.145) similarly suggest that, despite the early emphasis on programming, most users were "content to buy commercially produced games tapes" rather than to code their own. It is recorded that computer games made up 60% of home software sales during the 1980s (Campbell-Kelly, 2003, p.276) but it is equally true that the popularity of commercial game software does not preclude the use of the same machines to write code (although it may have diverted users' available time and attention away from such activities).

By 1988, however, hobbyist programming was perceived as being in decline, and magazines responded by ceasing to print code for their readers to copy (Wells, 2014). This apparent ambiguity about microcomputers and what they were "for" continues into contemporary histories of that period. For example, in a 2011 BBC article, Gordon Laing (editor of Personal Computer World during the 1980s) described how the ZX81 microcomputer;

> …started off a proud tradition of teenage boys persuading their parents to buy them kit with the excuse that it was going to be educational … It was no use for school at all, but we persuaded our parents to do it, and then we just ended up playing games on them." (BBC, 2011)

Within the same article, however, journalist Stephen Tomkins contradictorily credits the ZX81 with creating a generation of software developers. There was, therefore, a contested notion of what the term "educational" meant when applied to the home computer. The ZX81 used by Laing may not have lived up to its potential as an educational device for application across recognized school subjects, but micros did appear to provide an avenue for learning about programming – something that IT-workers who grew up during this period attest to in the following sections. In their history of game platforms, Loguidice and Barton (2014, p.138) similarly note that 1980s microcomputers remained popular for longer in Europe and the UK, which meant a geographically-specific generation of "bedroom coders" who would go on to work in the IT industry.

Educational studies conducted during the 1980s (Fife-Schaw et al., 1985; Mohamedali et al., 1987) contest the conception of gaming as something which diverted youth from more "serious" uses of computers. Fifre-Shaw et al. (1985) and Mohamedali et al. (1987) observed that

children and teenagers in England - though predominantly boys - were progressing through a predictable, sequential pattern of socialization. This began with playing games, then moved onto using software tools and finally onto learning a programming language. Games were thus seen to serve an "interest maintenance function" (Charlton, 1999, p.4) keeping some children - who were predominantly boys - enthusiastic about computers and giving them a template for their own programs. These young hobbyists experienced a symbiotic relationship between gameplay and the "productive" sort of computing, which would give them a head-start using computers at school or in future jobs. To take one existing example, Matthew Smith – the programmer of the ZX Spectrum game Manic Miner (1983) recounted how during the early 1980s he and his teenaged friends had spent time fraternizing at the local electrical shop, where they would also be offered casual programming work by business customers on the basis of their hobbyist experience (pixelatron.com, 2010). Importantly, however, this leisure-education relationship was heavily platform-dependent. Playing Pong on a standalone games console might prompt a consideration of how it was made, but it was impossible to actually produce a 'clone'[17] of a console game without undisturbed access to a microcomputer on which to program.

3.1.2 The Role of Micro Gaming in IT Professionals' Informal Learning (-1990)

There have been numerous studies into the hobbyist programming scenes of different countries during the 1980s; the Netherlands (Veraart, 2011) Finland (Saarikoski and Suominen, 2009) then then Czechoslovakia (Švelch, 2013) Australia and New Zealand (Swallwell). Although the uptake of different machines and brands during this period differs from country to country, these researchers generally agree on the centrality of game-making to hobbyist programming scenes at this time. One point of similarity when comparing this body of research from different cultures is that hobbyists did not always view games solely as objects of leisure and entertainment. The older research participants in the present study, who were programming during this period, provide further evidence of how games were used as "a way of demonstrating the technical possibilities of microcomputers" and as "learning tools for programming" (Saarikoski & Suominen, 2009, p.24). The home production of games was a practice which provided "proof of coding skills" and was, therefore, evidence of a type of technicity (Švelch, 2013). In these cases, the practices of playing, analysing and programming games fit with Stebbins' (1982) definition of serious leisure, with the leisure activity oriented around self-improvement as opposed to pure hedonism, playing a key role in respondent's later identification as techies or computer people.

As noted in the previous section, critics at the time had some difficult conceiving of computers as vehicles for both leisure and work gameplay (Adamson & and Kennedy, 1986; Murdock et al., 1992). This was perhaps a product of the machine's newness. While the multi-functionality of the personal computer seems evident to most of its users today, the function of home computers had yet to be fixed in the 1980s, and perceptions of their utility varied wildly between households. A comparison of the testimonies of three different early-adopters is

[17] 'Cloning' refers to the practice of copying the mechanics of an existing game; something several of the research participants took part in during their youth.

indicative of this heterogeneity. Greg, for instance, recounts how his father bought a 1984 Amstrad CPC464 solely as a games machine for him and his brother. Although Greg remembers using the machine for programming, this had not been his father's original intention:

> Greg: My dad thought games were a waste of time. But he still bought the Amstrad for our entertainment … he was quite surprised when I started programming on it in BASIC. My sister was having difficulty doing multiplication at school and I worked out how to make a program to help her with it.

Greg's early forays into programming were an unforeseen application of what had been intended as an object of play. In contrast, Neil used his Dragon 32 (a gift from his maternal grandfather) primarily for programming games. Because Neil's mother had worked as a programmer on large mainframe computers, there was already a sense of the computer as a "tool" in their household, as well as access to relevant textbooks and manuals:

> Neil: Gaming wasn't as widespread as today. I played some games but programming was my main interest … I enjoyed platform games and text adventures, but I often preferred to write games instead of play them.

Neil, now a software programmer, describes his early game-making in terms of a pleasurable "mental challenge". He is dismissive of these early creations as primitive or simplistic, but still offers one specific example which illustrates how games could be personal programming projects which were nonetheless loaded with personal meaning:

> Neil: I wrote a few silly little games, I remember when my brother was born I wrote a game which was storks flying over buildings dropping babies. I also made a lot of text adventures. They were easier because there's no graphic component.

Neil's stork game is testament to the everyday, almost diary-like quality of some of the games that early hobbyists would make, much as in Švelch's (2013) account of Czeckoslovakian teenagers autobiographical text adventures which dealt primarily with the daily business of life as a high-school student. While both programming and gameplay are sometimes imagined as solitary activities, both the stork and multiplication games in Neil and Greg's accounts draw on immediate familial events and are produced with that audience in mind. Such oral histories of early hobbyist game development preserve the more mundane and widespread practices which are, as Swalwell (2012) argues, often obscured in historical accounts by more spectacular and ideologically-loaded practices, as in Steven Levy's (1994) account of hacker culture. It is also worth considering whether and how the creative intent of young hobbyists' home-made games may have changed in accordance with the games industry's development from a small cottage industry in the 1980s - when, as another respondent puts it, every game was "very much the first of its kind" (Doug) - into a large media industry with production budgets reaching into the tens of millions of dollars. Early hobbyists

may have felt less likely to feel constrained by perceptions of what games should be "about" or "for", and also to have lower expectations about the sort of things they might produce[18].

While some writers (Adamson & and Kennedy, 1986; Murdock et a1., 1992) had tended to treat games as a distraction – the primary use of microcomputers which parents had been pressured into buying for their supposed educational value. A comparison of Neil and Greg's accounts troubles that characterization of micro-buying parents as dupes to educational computing rhetoric. Hobbyists-turned-professionals like these may only represent a small niche of early-adopters who programmed, and it is difficult to quantify what proportion of micro-users did what with their computers. But what seems evident is that, while one parent might have bought an educational machine which was used only for gaming, another would purchase a gaming device which would prompt unexpected experimentation with BASIC. Such is the unpredictable nature of incidental learning.

For David, the various Sinclair machines he owned through the 80s were described as "probably a godsend" for his parents, keeping him "quiet for hours on end" programming simple arcade games. The family shared a caravan at the time, while David's parents built their own house. David, like Greg, does not recall any explicit educational intention on the part of his parents when purchasing the computers used by him and his brother. For David – whose older brother had bought and assembled one of the earliest Spectrum kit-computers – these machines were linked to a pre-existing culture of hobbyist electronics, already present in his home, and not viewed as distinct, separate objects:

> David: Computing was seen differently then. My brother had electronics bits and bobs and he was doing circuitry and stuff, it was seen in the same vein as that… Our school had an electronics guy who did an electronics GCSE that I did as well, and he did a bit of computing as part of that.

David's point that computing was viewed as part of the field of general electronics reiterates Leslie Haddon's (Haddon, 1990, p. 8) observations about 1980s hobbyist computing – that it sat in a historical continuum with older male-centric cultural forms like pinball and kit-built electronics. Haddon suggests that magazines geared toward early computing hobbyists;

> … provide some insight into the nature of their prior interest in electronics … these audiences are assumed to show an interest in such a diverse range of electronics that they must be motivated beyond the narrowly conceived benefits of any particular item. Technology is assumed to be pervasive in their lives.

David also recounts how an "electronics guy" taught the programming half of his computing course - the other half of which was oriented around teaching girls to touch-type in preparation for secretarial jobs. This account highlights how programming was taught in strongly gendered ways in some British schools as early as the late 1970s, despite the professional legacy of female programmers such as Neil's mother. As such, while the gamer-programmer world of boy hobbyists may have constituted one avenue of socialization into tech

[18] This topic is explored further in relation to a cohort of younger ICT students in Chapter 5.

jobs for men in the 1990s and beyond, it is also important to remember that powerful institutions like schools continued to shape career pathways along strictly gendered lines. Computing education during this period was closely linked to science and mathematics, both of which were frequently perceived as masculine and dominated by boys (Boaler, 1997). As Nathan Ensmenger (2010, p.136) argues, computer programming "started out with an ambiguous gender identity" and was "gradually and deliberately transformed into a high-status, scientific, and masculine discipline". The gendering of programming as an activity, however, might be circumvented by familial relations. For example, one female participant recounts:

> Sarah: I started with a VIC 20, and that was because my uncle had a VIC 20; he preferred the VIC 20 to the Commodore 64 … So had that, but then nothing until secondary school and it was like 4th year, going in to GCSEs was really the first time we got on computers again.

The biographical accounts of these participants frequently foreground the role of familial gatekeepers – such as Neil's COBOL-programming mother, Sarah's hobbyist uncle, or David's electronics-enthusiast older brother – in shaping the local, domestic meaning of the micro for the young enthusiast. Whereas Neil and David speak mainly of programming, Doug better fits the description of the non-programming micro gamer, describing his earliest computer-interactions in the following terms:

> Doug: My dad bought a BBC computer for Christmas. Earliest memories are playing Yellow River which is a very, very early sim. I moved onto Elite, one of my favourite games of all time … an awful lot of very fond memories of sort of Chucky Egg, Repton, Thrust, Imogen - all sorts of weird and wonderful things from way back then.

For David and Neil games provided a creative outlet in the form of projects to test and improve one's' programming ability while also often having an expressive or diary-like quality in terms of their thematic content. In contrast, Douglas recounts happy memories of commercially-produced games during a period when "everything was very much the first of its kind". These responses illustrate the inappropriateness of reducing the uptake of computers to a binary of education or leisure. The diversity of early orientations among those who went on to become computing professionals illustrates what Haddon and Skinner (1991, p.435) describe as the "competing conceptions" of the role of microcomputers during the 1980s. Even Doug, who does not foreground the "learning" role of his earliest machine, went on to several jobs in IT.

Most importantly, the technical affordances of the platform, with its up-front, easily available programming environment go some way toward illustrating the proximity of games and programming for those who owned and used micros. As one participant (Greg) put it; "BASIC was what it said on the tin. It just gave you the flavour of the mind-set. It's like what play-dough is to bricks and mortar." People like Greg, who continued programming throughout the following three decades, exemplify a type of connection between the earliest types of home gaming and hobbyist learning. This orientation was not held by every person who played games on micros, rather Greg and his contemporaries represent a distinct "gamer-tinkerer" orientation in which gaming-related activities - in this case, programming simple games - played a bridging role into computer literacies which would enable their adult professional careers.

The reasons why parents bought the earliest home computers were varied, and did not always coincide with how they were eventually used. As Greg's anecdote about DIY home-education software shows us, this did not always mean that machines intended for "productive" uses were misappropriated as tools of play. The computer's multi-functionality was what differentiated it from earlier hobbyist electronics and also from games consoles, and allowed boys like Greg a sort of accidental apprenticeship in programming despite some cynicism during the 1980s toward the idea of a machine which could play games being used for educational ends. Machines of this period foregrounded programming due to the availability of BASIC, but it was up for young users to make use of them in this way, with family members playing a key role in providing access and encouragement.

3.2 The Rise of the Modular Gaming PC

3.2.1 Technical Changes in Computers and Gaming Following the "Micro Period"

Following the "micro-period", the personal computer underwent significant technical changes during the 1990s. It is important to understand these shifts, as they are key to understanding the changing role of games as inculcators of technical knowledge. From the microcomputers through to the Amiga 500s and Atari STs of the late 1980s, early home computers shared one major similarity with games consoles, in that game software was produced for a specific make of machine, and could usually be expected to run on that machine, excluding some fault in the cassette, floppy disk or console cartridge. While the early microcomputers came pre-built with BASIC available on start-up, these newer PCs would offer less obvious routes into programming, due to the advent of graphical operating systems like Microsoft Windows, while offering more opportunities to learn about the machine itself.

For the most part, consoles and early home computers were generally conceived as closed systems, with users discouraged from viewing or altering internal components (aside from the earliest kit-built microcomputers)[19]. In contrast, the key defining feature of personal computers from the 1990s onwards is an increased level of modularity. This was a product of improved technologies for generating sound and visuals, but also an acknowledgement of the growing heterogeneity of PC users. A general office user may only need standard parts; a music producer might need an advanced sound card and greater amounts of RAM memory; while someone wanting to play cutting-edge games would require a sound card, extra RAM and an additional piece of hardware for improved graphics. By the end of the 1990s, three-dimensional games like Half-Life (1998) and Quake 3 Arena (1999) would be defining whether an individual PC was a gaming machine or office equipment.

[19] There are some exceptions: earlier microcomputers had often featured additional hardware peripherals such as external storage drives and printers, while third-party hardware like the Game Genie allowed gamers to input cheat codes for games on the first two generations of Nintendo and Sega consoles. One respondent (Jeremy) described "hacking away… with a Stanley knife" at an internal component in an Amiga 500 at around 1990; an unauthorised hack to increase the machine's graphics memory.

Fig. 7: List of technical specifications for running Quake III: Arena (1999) taken from the back of the game's original box

QUAKE III: ARENA: MINIMUM SYSTEM REQUIREMENTS

- 3-D Hardware Accelerator with full OpenGL® support*
- Pentium® 233Mhz MMX® processor with 8 MB Video Card **or** Pentium II 266Mhz processor with 4 MB Video Card **or** AMD® 350Mhz K6®-2 processor with 4 MB Video Card
- 64 MB RAM
- A 100% Windows® 95/98/NT 4.0 compatible computer system (including compatible 32-bit drivers for CD-ROM drive, video card, sound card and input devices)
- Windows 95/98/NT 4.0 (with Service Pack 3) operating system
- 25 MB of uncompressed hard disk space for game files (Minimum Install), plus 45 MB for the Windows swap file
- Quad-speed CD-ROM drive (600 K/sec. sustained transfer rate)
- 100% DirectX 3.0 or higher compatible sound card
- 100% Microsoft-compatible mouse and driver
- 100% Windows 95/98/NT 4.0 compatible joystick (optional)

- All 3dfx chips
- ATI Rage Pro & Rage128
- S3 Savage 4
- nVIDIA Riva 128 and 128ZX
- nVIDIA Riva TNT and TNT2
- nVIDIA GeForce 256
- Matrox G200 & G400
- Intel i740

- Multiplayer Requirements:
  - Internet (TCP/IP) and LAN (TCP/IP and IPX) play supported
  - Internet play requires a 100% Windows 95/98/NT 4.0-compatible 28.8 Kbps (or faster) modem

* A 100% full OpenGL compliant 3-D video card is required. Quake III Arena uses OpenGL to support 3-D hardware acceleration. Quake III Arena has been tested on many but not all of the major cards incorporating the chipsets listed below. For the most recent list of cards and drivers supported, please visit **www.activision.com**.

By the mid-1990s PC gamers would find themselves checking to see if their own computer's technical specifications met those required or recommended by a game's packaging. Fig. 7 exemplifies the seemingly overwhelming amount of information a PC gamer in the late 1990s would have to have known about their PC in order to ensure it would run a 3D game at the time. Rendering 3D graphics in real-time requires specialized hardware components called graphics processing units, otherwise known as GPUs or graphics cards, to be installed. The fifth generation of games consoles – such as Sony's PlayStation and Nintendo's N64 – contained integrated GPUs capable of producing 3D graphics. In contrast, playing an equivalent 3D game on a PC would require the user to buy the graphics card as an additional component, and also to install it – a potentially daunting task for someone unused to looking at the inside of a computer[20].

The rise of 3D gaming during the 1990s is, therefore, a point at which the console and PC become increasingly distinct as gaming platforms. The openness of the PC system, with its modular set of internal parts, meant that playing contemporary 3D games on it required an extra special effort (and financial expense) on the part of the user. Building a PC from scratch involves the incorporation of an external case with a power supply unit, random access memory, processor (CPU), hard drive, and a motherboard through which all of these other internal parts are connected (see Fig. 8). Optical drives for CDs/DVDs were optional but mandatory for game installation before the advent of pay-to-download services. A gaming PC might require the addition of a graphics card (GPU) and an upgraded sound card to provide higher fidelity audio than the one usually integrated into the motherboard, as well as the provision of additional components for cooling and ventilating machines running at higher capacity. Consoles are closed systems, in that their manufacturers keep all of these various components neatly tucked away out of sight.

Whereas hobbyists in the 1980s had the means and motivation to write their own games, the relationship between gaming and hobbyist computing changed considerably during the 1990s, partly as a result of the technological changes outlined above. Because games had moved on – both technologically and aesthetically - it was comparatively more difficult for young newcomers to produce their own games at near-commercial quality, as had been the case with the less complex game genres in the 1980s. In addition, graphical operating systems like Microsoft Windows had gradually become an accepted norm. This meant that the idea of booting a computer directly into a programming environment was increasingly alien. One area

[20] As others have noted (Simon, 2007; Bell & Dourish, 2007) the Apple brand has generally rallied against this aspect of hobbyist computing culture, preferring devices to be self-contained and without the need for tinkering with internal parts. The Mac has come to be associated with creative media and fewer games tend to be produced for it.

where the symbiotic relationship between gaming and more 'productive' uses of computers was maintained, however, was within cultures of game modding.

Fig. 8: Internal, modular components of a PC 'tower'

The practice of modding gained popularity during the second half of the 1990s, with amateurs adding to - or otherwise altering - existing commercial games; a practice often encouraged by the original developers (Kücklich, 2005; Au, 2002). In 2013 a nexusmods user with the screenname Trainwiz made publicly available a mod for the high-fantasy game Skyrim (2011) which replaces the game's dragon enemies with characters from Thomas the Tank Engine by replacing their visual models and audio (see Fig. 9). This exemplifies a mod whose primarily appeal is aesthetic. Modifying game content can mean any number of things, from cosmetic changes to in-game art, to scripting entirely new missions or narratives using something closer to a traditional programming language[21]. As such, the educational takeaway from modding is largely dependent on what type of modding is taking place; a point shown by case studies of the practice in schools (Seif El-Nasr & Smith, 2006). Modding communities are undoubtedly sites where technical learning occurs, but as established in the literature review (1.2.4) it is inaccurate to assume any widespread direct link to the types of technical skills associated with high-status jobs in IT. Rather, it is likely that such activities contribute to a generalized sense of technical proficiency, with only a small amount of modders learning specific programming skills.

[21] Some games use proprietary languages for modding (such as Blizzard's JASS language used by some modders of Warcraft III and Starcraft II) while others use more widely-known programming languages (Valve's Source Engine, used for Half-Life and Left4Dead games, uses the C++ language).

Fig. 9: Community screenshot from *Skyrim* (2011) incorporating the "Really Useful Dragons" mod

If some have learnt computing principles through modding, it is important to note that this practice remains exclusive to the PC platform, although some console series do have built-in level editors. From the Tony Hawk (1999-) skateboarding games to the in-game game-design of LittleBigPlanet (2008) and Mario Maker (2015) many console-gaming series do offer the opportunity for console-gamers to make - and more recently share – creations. However, player-creativity in console games generally occurs within the developer-sanctioned confines of the original game's software, whereas PC-game mods are made using separate, external programs and often using software and skills with a broader applicability outside of the gaming hobby. Broadly speaking, the emphasis among PC hobbyists had – throughout the 1990s and early 2000s - largely shifted away from the wholesale production of original games and other programs, and had new foci; hardware upgrades and modding commercial games.

By the end of the 1990s, some PC enthusiasts were using game performance benchmarks such as FPS (frames per second) as a way of evaluating the power of their home-built machines. Bart Simon's (2007) ethnography of a LAN party records PC-gamers' practices of 'case modding' and 'overclocking'. In this usage, 'modding' refers instead to modifications of the computer itself, such as the customization of PC towers, while 'overclocking' refers to forcing computers to increase performance "beyond any game-based usefulness" at the risk of breaking parts (ibid. pp. 185-186). In Simon's view, such practices can be linked back to earlier technology-related subcultures which were also male dominated; they are "hot rodding for geeks"; an observation which reiterates the continuity noted earlier between microcomputers and hobbyist electronics. These higher risk activities evidence a more serious orientation to an activity frequently understood as casual entertainment. Computer games continued to play a demonstrative and diagnostic role (Haddon, 1990) thus connecting them and the people who used them in these ways with the broader world of computing. In this case, individual users sought pleasure in not only the gameplay itself but in the way that smooth gameplay was indicative of their own technical prowess. Rather than making a game to prove one's programming ability, some gamers were using game performance to illustrate their ability at building machines.

There had been a general shift in focus, from one of programming software on a microcomputer, to one of running software on a comparatively more expensive and complex

machine. But this is not to say that younger techies who began their computing careers with an interest in the computer's physical guts would not go on to learn how to program. Rather, as some of the respondents' biographies illustrate, the technological specifics of the modern PC would mean that programming would feature later in the biographical sequence of events leading some young gamers into IT careers.

3.2.2 The Role of PC Gaming in IT Professionals' Informal Learning (1990s-2000s)

It is not uncommon to find IT professionals in their twenties who have learnt some sort technical skill they apply at work through teenage hobbyism. However, some older members of this professional group see their socialization process as distinct, due to the relative lack of formal educational pathways in computing at the time, for example, Neil gives the following account:

> Neil: I've got a number of friends who are of a similar age to me who taught themselves at home, and I think once you get into the later 90s - after Windows 95 came in - the whole ecosystem changed a little and the hobbyist died out a bit after that, so the majority of people you get coming in to work in development and IT these days have come in through a university course… that's not to say there weren't some that did early but it was much less common to do so. There seems to be a real difference in approach, depending on whether you've been through the university track or whether you've taught yourself. I suppose I'd class myself as an enthusiastic amateur, really. Tinkering with things, breaking them, learning how to fix them.

This perception of a hobbyist route in decline is, however, contested by the accounts of respondents who were born in the late 1980s or 1990s and continued the trend of the "enthusiastic amateur", albeit within a changed hobbyist learning ecology, where BASIC was no longer a standard feature of most computers, and where more hobbyists first encounters with computing would come in relation to the hardware.

Lee and Max represent this younger generation of IT professionals than those who spoke in the first part of this chapter. As such, they exemplify a slightly different technicity than the older research participants, albeit one which still falls under the 'gamer-tinkerer' category occupied by the 1980s micro-users earlier in this chapter. Lee is a 26-year-old user-interface designer at a games studio. He began learning programming languages relatively early for someone born on in the latter part of the 1980s, having learnt some QBasic[22] with a friend before he was ten. He describes the experiences that lead to him eventually learning to program games in Flash[23] during the early 2000s.

[22] A later version of BASIC from 1991 which could run in DOS or from within graphical operating systems such as Windows or Linux.

[23] Adobe Flash had been a popular format for web-hosted games since the mid 1990s.

Lee: ...Playing a PC game wasn't as simple as putting it in, installing it, playing it - it was putting it in, installing it, trying to play it, figuring out why it wouldn't work, and then tweaking until it suddenly worked, and then just playing it as quick as possible until it stopped. But just that tweaking kinda gets you fairly deep understanding of how that sort of stuff works ... you know, when you're ten and you edit the autoexec so you can have a bit more RAM so you can play Ultima 8 - that sort of thing sticks with you.

Lee's experience of installing PC games during the 1990s inculcated a sense of ease with computers, even if it bore no overt relation to the programming he would eventually go on to do at work.

24-year-old Max works as an IT engineer in a technical support role, attends PC-gaming LAN parties and also programs open source software to help others facilitate LAN gaming events. Max recounts building his own computer at the age of 13, using £500 of personal savings for the components. Despite this machine being comparatively cheaper than new microcomputers had been in the 1980s[24], it was still notably more expensive than the consoles of the time (for example, the PlayStation 2 initially retailed for £299 in 2000). Max's father frequently visited Hong Kong, on business for a technology company. There he purchased - on his son's request - a top-end graphics card from one of the city's "crazy computer markets". This component would allow Max's computer to run Quake 3 at 125 frames per second, considered the "magic number" for aficionados of the game. Following this initial build, Max would build a new computer every three or so years, upgrading individual parts gradually in the time between full rebuilds.

The personal computer, in cases like this, is not just a vehicle for gaming, but also an object of personal pride, with gamers like Max using games as diagnostic tools for demonstrating the power of their machines and their knowledge about the hardware. If programs crafted by early micro hobbyists were, as argued by Švelch (2013) expressions of a specific technicity, then home-built PC-gaming rigs often perform a similar function.

Among the IT professionals interviewed, expressions of this sort of esteem-building through tinkering are not exclusive to gamers. For example, Sarah recounts keeping a study computer "alive" for many years during university. The following long exchange between myself, Sarah (38) Ewan (27) and Phillip (24) speaks to the varied experiences of maintaining and upgrading a computer's hardware:

JBW: Is it important for a young person to have sole ownership of their own computer so they can really tinker around?

Sarah: Yeah, I think you're probably more inhibited on a public computer where you're like I probably shouldn't do that. Whereas on your own computer, you'll do anything to it.

Ewan: Saying that though, I don't know if this field attracts a certain mindset though, 'cause when I was in school and on the public machines in there the first thing I

[24] Compared to the microcomputers of the 1980s that usually cost over half a month's average earnings, a £500 computer bought in 2002 would have cost closer to 1/3 of a month's average earnings.

was trying to do was "why can't I play Minesweep"? "Why won't you let it let me have Paint?" And I found a way to get Paint and Minesweep up do you know what I mean, my mind was already wired like that.

JBW: Finding little workarounds?

Sarah and Ewan agree

Sarah: I mean I probably learnt, I got my first computer when I went to uni and mum, dad just sort of made themselves poor to get it. But then by having that and having to keep it upgraded and keeping going that's where I learnt most stuff, it's like well I'll just take it apart and put a new motherboard in, you know.

Phillip: It was more playing games for me really, just trying to get this game working, like why can't I play this game on my laptop.

Sarah: It's the problem-solving aspect of it where you learn a lot of stuff. But if you're just using someone elses machine it's someone elses problem possibly. Yeah, you've gotta keep that thing going. I mean back in the day it was a time machine like mum and dad were paying so much a month and they were still paying for it long after it would've died if I hadn't kept the thing going. I'd say the only original bit left by the time I came back from uni was the box it was in, y'know the motherboard and everything else had sort of changed.

JBW: What were you using it for? Were you using it for anything particularly intensive that you needed to upgrade it for?

Sarah: My degree was in design and engineering but obiously a lot of what i think it was AMI Pro at the time instead of Word um and stuff, uh, I don't know if I had a bit of CAD on it but y'know nothing monstrous but it was a 750 meg harddrive new, pentium 75, it's 'yknow, and then you've got windows on it, i think it came with 8 meg ram but they said you know it needs a minimum of 16 meg ram to run, so straight away you've gotta upgrade the ram so that it'd actually perform in any way that was sensible but...

Ewan: My first spec problem was, as Phillip said, I tried, my friend came over with Max Payne and I say oh my god I've heard about this game! this is awesome! Put it in, installed all of it, clicked go and it was like you need 97 megs of ram to run this game... and I was just... I had 64. I was very upset about that, like all night. The next day I went to town and ticked[25] the machine off the local computer shop and spent a few months paying him back.

It is important not to attempt to make Sarah representative of all women working in tech, especially given as the purposive sampling yielded a 3:18 gender ration of female to male participants. However, it is also difficult to ignore, in the above extract, the relative importance placed upon game-related upgrades in the men's accounts, compared to Sarah's more work-oriented hardware upgrades. It is not so much that Sarah is disinterested in games - she speaks elsewhere in the group interview about owning consoles. Rather, her parents' purchase of her first personal computer was primarily for study, whereas Ewan and Phillip both cite PC-gaming related "spec problems" as some of their earliest technological learning experiences.

[25] "Tick" in British slang means to purchase something on credit.

In addition, some of the older techies who had begun their hobbyist careers on microcomputers would go on to become rig-building PC gamers during the 1990s. Not every one of Max's peers at the LAN party where he was interviewed seemed to share his enthusiasm for home PC building. However, the discussion of technical specifications was common enough to be seen as central to at least one version of the PC-gamer identity. Whether in discussions with older non-gaming IT professionals, or with the LAN-party attendees who were also IT workers, hardware talk would enter conversation as a way of marking the passage of time. Hardware talk appeared to function as a way of asserting superior knowledge on newer or younger members of the community through phrases to the effect of "I was around when…" There is a significant theme of hardware-centric talk among those who work and/or play with PCs, as opposed to the more closed systems available for work (such as Apple products) and leisure (such as games consoles).

In contrast to Max's memories of rig-building, Lee's account focuses on manipulating software but still illustrates how the type of "tinkering" required to get an unstable PC game to work might make an adolescent feel more confident with machines; in his words, to feel like "the computer guy";

> Lee: I think as a kid you feel quite special being able to do things that not many other people seem to know how to do … it wasn't until I was in high school when I decided that I actually wanted to do something with computers, y'know. I'd been the computer guy for years and then suddenly thought "yeah actually I could actually have a job doing this".

This self-identification as the "computer guy" can be viewed as an everyday expression of a type of technicity. This will be explored at greater length in the next chapter, which focuses more on the attitudinal dimension of the PC gamer/tinkerer identity. At this stage, it is important to reiterate that the PC has tended to demand a greater investment of time, money and knowledge in order to produce an up-to-date and pleasurable gaming experience, in contrast to platforms designed exclusively for gameplay. It is the technologically demanding nature of personal computers which makes PC gaming a relatively niche hobby which is more closely experienced as "serious leisure" (Stebbins, 1982) in the sense that it is closely aligned with hobbyist computing. PC gaming often requires a greater investment of learning, whereas games consoles are designed around accessibility. As such, universal claims about a connection between computer literacy and the general activity of gaming should be viewed with some scepticism. Exactly how PC-gaming IT professionals view this contrast of platforms is discussed at greater length in the next section.

As previously discussed, the majority of the 21 adults with whom I spoke considered themselves gamers, or had done so in the past. This gaming majority were heavily invested in the pastime, and most would not identify with the 'casual gamer'[26] label in terms of the amount of time they played, and their game preferences. Some, like Cameron or Aaron, both in their late twenties – were what Juul (2012, p.162) describes as "lapsed hardcore" gamers. They had grown up playing all types of games on different platforms, but claimed to have less time for it as adult professionals (yet could still hold conversations about games which had been released

[26] the problematic usages of this term within the gaming community itself are discussed in 2.1.2

in the previous year or so). Others played consoles infrequently and did not keep up to date with new releases (Sarah) had no interest in contemporary games (David and Neil) or enjoyed games but actively avoided them over concerns for them being a "time sink" which they had little time for (Chael, Aaron). The places where gamer and IT worker identities seemed to coalesce most clearly where in the LAN party I visited, and among the game developers I spoke to at their workplace. A link between games and IT-careers is perhaps unsurprising in the cases of game industry workers like Nigel, Lee, Jeremy and Mark, all of whom had undergone a mixture of formal computing education and their own home-tutoring through hobbyist game-programming.

Although they were younger, the hobbyists who went on to become game developers had similar early experiences of early programming as some of the 1980s hobbyists discussed in 3.2.2, albeit through different means and perhaps with different goals. For example, while none of the 1980s hobbyists discussed any desire to make publishable games is BASIC, Lee began coding in a period when sites such as Newgrounds were making it possible for anyone who could program Shockwave Flash to make uploadable games which could be played in web browsers. Despite these differences, however, the young game developers and the older IT workers all express a similar early experience of making games as a sort of challenge, to see what the computer could be made to do, and to impress friends and/or family.

3.3 Variations in the Gamer-Tinker Technicity: Observations from a LAN Party

The LAN party I attended attracted a number of IT workers, several of whom had been organizers of the event for several years. These attendees were identified through an initial survey, and during the event itself invited to talk about their earliest experiences with technology and what brought them into their current jobs. Some of these discussions focused heavily on preferences for a particular technological platform for gaming, which will be explored here. These accounts exemplify the role played by platform preferences in the formation of technicities associated with computing careers, while also illustrating a degree of diversity. There is, however, an initial need to unpack some of the ways PC-specific gaming culture is currently perceived and discussed online, as this was something which strongly inflected some of the accounts given by participants, particularly in the case of group interviews.

3.3.1 PC-Gaming: the Online Discourse

The PC can be characterised as the historically less popular gaming platform, due to demands placed on user finances, labour and knowledge which are partly erased by the easy-access design of games consoles. There is, broadly speaking, a perception of techno-cultural elitism in and around PC-gaming culture, visible in discussions on popular online sites[27]. Understanding this perception is important because it frames how some of the PC-gaming IT workers framed their own platform preferences, which are discussed in subsequent sections. This section will

[27] for a more in-depth discussion of the material differences between PC and console platforms, and the existing research on the player-demographics of each, see section 1.2.3 of the literature review.

discuss salient ideas about PC gaming through a critical reading of several texts from a mixture of game fans and gaming journalists. In some cases, PC preference is framed more in terms of the play experience or the feeling of different control schema. As one interviewee explained their preference:

> Aaron: …first person gaming like Quake or Call of Duty, I don't believe they belong on a console. Personally, it doesn't make any logical sense to me. Coz you just can't move the same way you can move with a mouse and a keyboard. So while I like beat 'em up or racing games on consoles, I think first person shooters are mainly for computers.

Gee similarly notes that the control schema of the PC attracts some while repelling others and that "these matters are connected to their identities as game players" (Gee, 2003, p.34). However, beyond these discussions of controls and game "feel", platform-specific fandoms often involve negative characterisation of other types of players. These inter-platform aggressions were addressed in an earlier discussion of "hardcore" gamers' denigration of a presumed female audience for new casual games (1.1.2) but are also visible between players of "hardcore" games on different platforms. At the time of writing, one of the top[28] definitions of "PC Gamer" on urbandictionary.com is defensive:

> Informed and eager gaming hobbyist who has logically found and uses the best gaming platform, PC. The interesting and disappointing aspect of PC Gamers is how maliciously, ruthlessly, and ridiculously hated they are by other gamers.

In contrast to this celebratory wording, definitions for "PC Elitist" are often more accusative in tone:

> Every console has their fanboys[29]. But none of them are nearly as annoying as PC fanboys, otherwise known as PC elitists.

In the current example, a preference for the more esoteric gaming machine is described as either "logical" or "elitist" by different parties. 'Fanboy', as used in the second excerpt, is a gendered and often derisive slang-term broadly in gamer culture in relation to enthusiasts for different systems, often to the exclusion of other platforms. Despite its problematic gendering, I use 'fanboy' for the remainder of this chapter, to preserve an insider perspective. In more clinical terms, a fanboy or fangirl might be better described as a 'platform exceptionalist' in the sense that they play one platform while totally rejecting others.

The view of the PC-gamer as an elitist snob is visible in fan-definitions such as those above, but also in the accounts of games journalists. In a series of articles titled "A Guide to Recognizing Your Gamers" British games journalist David Houghton (Destructoid.com, 2007) describes an archetypal gamer type - the "PC snob" - who believes that "complicated

[28] I.e. receiving the most positive votes by users of the site.

technological issues are the only way to earn the right to play a game" and therefore prefers games with "bleeding edge hardware specifications" which require up-to-date components. Houghton's article attempts to explain the origin of this sort of gamer (using stereotypically gendered terms);

> It may be that his parents didn't want him wasting his time playing video games, and so sneaking a copy of Doom onto the PC they bought him to do his homework with was his only option for a long time, leading to a lifetime of repressed console jealousy. Or it's entirely possible that he's always been a diehard techie at heart, and that gaming became just one of his uses for the machine he proudly built with his own two hands. He may even simply be an over-achiever, finding insufficient satisfaction in merely mastering a game, and thus feeling the need to make the actual process of gaming a challenge in itself.

While written with a certain amount of disdain and with a presumed male target, Houghton's article is useful in that it proposes a diverse set of explanations for PC exceptionalism which do resonate with some of the accounts given by my own research participants. Firstly, there are those whose preference for PCs was partly informed by parental influence – such as encouraging PCs over consoles or outright banning consoles or certain types of game from the house. The second part of the above excerpt talks more technical pride. There is, for some PC gamers, a sense of exclusivity and of being in-the-know in the face of more widespread and publicly visible console-gaming. Cameron, a web developer, outlined his PC-gaming preferences in quite fatalistic, nostalgic terms, suggesting that PC gaming was a "dying thing… on its way out" and that no one still has "a tower under their desk". As discussed previously (1.2.3) PC gaming has seen an increase in overall popularity, owing to the popularity of new genres requiring less powerful machines. What Cameron describes is perhaps less the death of "PC gaming" in general, but more a decentring of the technically-oriented rig-building type of PC gamer described in Houghton's Destructoid article.

Other sources within the enthusiast videogame press have lampooned the "PC snob" stereotype through attention to the design of PC-exclusive games. Ben "Yahtzee" Croshaw is a British-Australian web personality, known primarily for Zero Punctuation – a series of sardonic cartoon videogame reviews. In 2008, he coined the term "glorious PC-gaming master race" in a review of PC game The Witcher (2007):

> … Witcher is very much a PC-exclusive game, which are typically designed to be as complex and unintuitive as possible so that those dirty console-playing peasants don't ruin it for the glorious PC-gaming master race. The first warning sign is that the manual is thick enough to beat goats to death with, and then once you get into the game the interface is just a few steps shy of Microsoft Access in terms of friendliness ... If disliking this sort of shit makes me stupid, then call me Retard McSpacky Pants, but I'd rather be stupid and having fun than bored out of my huge genius mind. (www.escapistmagazine.com, 2008)

Note how Croshaw associates the game with Microsoft Access - a piece of PC database software associated with the more mundane business-uses of computers. In this original context, 'glorious PC-gaming master race' is used to sarcastically describe a particular set of tastes – where excessive complexity is favoured to the detriment of fun. The glorious master-race meme

is repeated in other publications and artworks (kotaku.com, 2012; Oh, 2012) as well as finding a home in Reddit.com in the Glorious PC Master Race subreddit[30], which has around 170,000 subscribers at time of writing. In the case of this subreddit the phrase loses most of its intended critical irony and is instead used to earnestly describe the supposed technical, moral and intellectual superiority of PC gamers over "console peasants". At the time of writing, the headline of r/pcmasterrace is "may our framerates be high and our temperatures low", a reference to the high on-screen framerates provided by powerful computers, while low-temperatures indicate that the machine is not even running at its full capacity.

A drawing (Fig. 10) posted to the Glorious PC Master Race subreddit – under the heading "[my] peasant friends tagged me in this" – offers some illustration of how the PC-gamer subculture is viewed by some console-only gamers. The left column shows a cartoon of a happy console gamer, followed by bullet-points with exclamations commending the game for being fun and having a pleasing art style, and saying "I can't wait to play this with my friends!" In contrast, the PC gamer column shows a disgruntled cartoon face glaring at a PC monitor. All text is in capital letters, to convey a sense of petulant rage. Here, the focus is on portraying the PC gaming community as obsessed with technology and graphical fidelity to the detriment of social fun.

[30] A subreddit is a subsection of the website reddit devoted to a particular cause, following, or type of discussion.

Fig. 10: Platform preferences cartoon (anon. posted to reddit)

Although the drawing is obviously meant as parody, it serves to describe how the PC gaming community can sometimes be viewed by those who prefer consoles. Another user goes on to post a rebuttal incorporating the PC Gamer Master Race character from the original Yahtzee animation. These perspectives are summarized in Fig. 11. In some cases, these negative perceptions of PC gamers arise as reactions to techno-cultural elitism. One example of this form of elitism was identified on a 2010 thread from a popular website[31] dedicated to PC gaming. Here, the original poster posits that console gamers are "less sophisticated" and draws historical parallels between console gamers and "barbarians". The poster associates the "console crowd" with the worst instances of rudeness, immaturity and racism, and associate PC gaming with a stoic mentality; the activity of saving up money and researching how to build a computer is framed in terms of moral and intellectual superiority through self-improvement and delayed gratification - indeed, those who had bought pre-built Alienware gaming PCs were placed in the same category as the less "sophisticated" console gamers by some of the thread's users. It would be misrepresentative of the online PC-gaming community to take this extreme perspective as representative of the whole group. Various websites upload opinion pieces or FAQs outlining theories of the PC's superiority[32]. While many users engage in these debates, others are more critical, seeing such articles as deliberate attempts at starting "flamewars" between fanboys in order to increase the amount of traffic through the site.

[31] The site remains unnamed to avoid the traceability of specific users through keywords.

[32] (e.g. (Rickets, 2008; thegamescabin.com, 2012; Social.bioware.com, 2012; pcgamer.com, 2012; n4g.com, 2013).

Fig. 11: Platform preferences (adapted from 2 anonymous webcomics)

Console gamer's depiction of…		PC gamer's rebuttal…
…themselves.	… PC gamers.	
Like games for their art style and enjoys playing them for challenge.	Picky about graphical fidelity to the point of not being able to play or have fun ("I haven't had any fun since 1997!").	Appreciate art style and can also improve upon dated graphics with hardware and mods.
Play/share games with friends.	Spend most of their time sharing "screenshots of the [in-game] floor" with friends, or downloading superfluous mods, instead of actually playing.	Can play online with friends, usually for free without any sort of subscription services.
		Have greater access to videogames from previous generations. Can save money through online sales, and don't have to replace the entire machine as with obsolescent consoles.

Contemporary PC gaming communities can be seen to hark back to the pre/early-internet 1990s, when being a computer geek was, as Kelty (2013, p.102) argues, less of a mainstream identity, and had the trappings of an elitist, esoteric cult. The attachment of ideas about self-improvement to PC-gaming exemplifies Stebbins' distinction between casual and serious forms of leisure (a theoretical position outlined in 1.2.2). The subjective experience of some leisure activities as more "serious" and as entailing some kind of "career" is visible in the values held by many PC gamers; a stoic commitment to assembling and upgrading a computer, and to saving money in the long run because games are often cheaper and more diverse than those released on the console. One article on gaming site Destructoid (2011) suggested that the PC platform had higher revenues from games software that year, and that PC gamers were spending, on average, twice as much time playing as their console-only peers – showing a relationship between higher investments of time and money. In some of the online discussions about gaming platforms, PC gamers express a feeling of having been betrayed by the games industry. Some PC gamers perceive themselves as having invested more time and money into an industry which, in turn, caters primarily to the more limited tastes of the console audience, with risk-averse practices which favour the production of a few more popular genres over creativity and experimentation.

One of the main theories put forward in Bourdieu's Distinction (1984) is that expressions of taste are primarily about positioning oneself socially. Platform-centric

expressions of taste "classify the classifier" (Bourdieu, 1984, p. 6) through an association with intellectual or moral superiority. When Bourdieu argues that taste "classifies the classifier" (p. 6) he is suggesting that individuals perceive and present themselves as morally better people based on the culture they consume, while casting others as either pretentious snobs or unthinking slobs. In some cases, a taste for something perceived as "easy" becomes associated with laziness (including moral laziness). As Bourdieu suggests in relation to snobbery:

> The refusal of what is easy in the sense of simple, and therefore shallow, and 'cheap', because it is easily decoded and culturally 'undemanding', naturally leads to the refusal of what is facile in the ethical or aesthetic sense, of anything which offers pleasures that are too immediately accessible and so discredited as 'childish' or 'primitive'… (1984, p. 488)

In the more extreme expressions of PC-fanboyism, the console is what is being characterised as 'undemanding', 'childish' or 'primitive'; a characterisation which transfers to the 'console kiddies' as well. The lay-concept of "fanboy" can also be understood as a type of technicity; a social identity bound up with uses of technology. Just as expressions of taste classify the classifier, expressions of like or dislike towards types of game genre or platform can signal different types of technicity; from those who use games primarily as a way to communicate, compete and relax, to those who are more involved in the technical aspects of machine assembly and maintenance.

What emerges in the cases of some PC-only gamers who also work in IT in some way reaffirms the stereotype of the PC snob in Houghton's Destructoid articles: that some PC gamers are "diehard techies" for whom gaming is just one use for the "machine he proudly built with his own two hands". What the following section shows, however, is that the PC "fanboyism" exhibited by some IT professionals is not always based entirely on a preference for PC gaming as an activity in itself, rather an acknowledgement that playing on the PC tangentially provides more affordances for creativity and learning. These affordances – such as the ability to upgrade a machine's hardware or alter game content – were outlined more generally in the literature review (1.2.3) but are reconsidered in the following sub-section in relation to the respondents' own expressions of preference.

3.3.2 The PC Exceptionalists

Contrary to the dominant image of the elitist PC gamer who shuns other forms of gaming, Max (24) and Greg (39) were the only interviewees to express some stronger form of PC exceptionalism; the belief that PCs were in some way 'better' than consoles. These two men share some biographical elements, but the serious leisure activities take different orders. For Greg, the affordances of the microcomputer (closed system with built-in BASIC) meant that programming came before hardware concerns, whereas Max's programming experience develops in his mid to late teens - several years after his first build – and initially in the context of HTML (basic website programming) before moving onto developing open-source software to run LAN parties. In both respondents' biographies, games appear to have been associated with the earliest steps onto a certain career path. As a whole, the PC is described as providing unique opportunities for incidental learning which are largely unavailable to console-only players. This

is reflected in the way these two research participants - both of whom I interviewed between game sessions at the LAN party - rationalize their console preferences;

> Max: I put it completely down to my dad's tech background and also - I don't know whether he necessarily encouraged it or intended it - but I've always felt that PCs allow you to be creative whereas the consoles don't, y'know? It's very clear that they are the content creators and you are the content consumers. And apart from all the gaming that I did on PCs, I was building them, and learning pigeon HTML, making websites for my Quake 3 clan... I've always had PCs because you can do so much more than just game on them; you can browse the web, which wasn't the case with consoles at the time when I got my PC.

Unlike many of his fellow LAN party attendees, Max has never owned a games console, and - as evidenced above - has strong beliefs about the difference between gaming platforms and the sorts of users and types of knowledge that they pre-suppose (or possibly produce). It is worth noting that Max's history is one of relative economic privilege (having £500 of personal spending money at age 13, at a time when many may have not been able to afford the £300 for a newly-released console). But in the above excerpt he also valorizes the incidental learning experiences he had as a result of being restricted to a single, open platform.

Greg is fifteen years older than Max, but he expresses a similar set of experiences and beliefs, relating his platform preference to the creative or learning experiences attached to it. For Max and Greg, being a PC exceptionalist or "fanboy" is not solely about play - it is a preference with a strong moral dimension, attuned to questions of socialization and creative empowerment:

> Greg: Consoles are just for running videos, games, music and browsing the net and watching movies et cetera. They're purely for entertainment and you can't do anything else but put on entertainment. PCs - and specifically coding environments - got us (well, me) thinking about how I could do something more with it myself. When people argue PCs verses consoles, it's a point I never see. Give a kid a PC and yeah, they start playing games, but have access to something they can get truly creative with too.

What both Greg and Max describe is not necessarily a preference for the experience of playing a game on the PC, as had been the case with Aaron's preference for the PC's controls. Rather, these two respondents value the hobbyist learning activities which can arise peripherally to PC play, as a consequence of owning an open-system platform (1.2.3). If games are part of a male-dominated "learning ecology" surrounding technology (Barron, 2004) then PC-exceptionalists like Greg and Max see PC-gaming as providing a learning ecology which is much more closely aligned with computer science and with ideals related to freedom and creativity. Greg goes on to connect his platform preference back to his childhood use of microcomputers, but laments that - even on the PC platform - the ease with which users might just get "stuck in" or "play" with programming may have eroded over the years. This he attributes to the emergence of graphical operating systems like Windows, which tend to "hide away" tools for programming.

To some extent, Greg and Max confirm the descriptions of the 'PC snob' discussed in the previous subsection (3.3.1). Houghton's description of this type of gamer had suggested

that, in such cases, the actual activity of gaming is secondary to being "a diehard techie at heart" and that this disposition may arise from parental-interventions; with consoles never being allowed in the house. To return briefly to Bourdieu's theories of taste; the PC exceptionalism of adult IT workers like Greg and Max is not expressed (at least not in these interviews) as the sort of open disdain for console gamers observable on online forums, discussed earlier in the chapter. Rather, they portray console gamers as passive consumers who are missing out on a form of self-improvement.

The 'PC exceptionalist' perspective is representative of a serious leisure orientation toward gaming and computers, compared to one which sees games as a more casual leisure form. These expressions bare a close resemblance to the distinction between computer users and designers as noted by Crutzen (2000) and further identified in Schulte & Knobelsdorf's (2007) biographical research with university students. Schulte and Knobelsdor found that those more closely aligned with computer science are likely to have a self-tutoring, active approach to computers, and to regard themselves as cultural insiders with superior knowledge. As such, the accounts of gamers like Greg and Max further illustrate the connection between specific types of gaming and insider status within broader computer culture.

3.3.3 The Cross-Platform Gaming Omnivores

It is important to note that while PC-gaming was a norm among the majority of the IT workers, PC exceptionalism was not. Many of the LAN-party attendees interviewed played consoles at home. This runs contrary to some of the more antagonistic online discourses described earlier, where the PC-gaming community is sometimes associated with exclusionary technical and intellectual snobbery. This, in itself, illustrates the problem with drawing assumptions about gaming communities based solely on data available from online communities. Note how the cautiousness with how the topic of platform preference is met in the following discussion between a group of friends; all of whom are IT professionals at the LAN-party:

JBW: What about other gaming, are you guys into consoles as well?

Danielle: Yep.

Tom: More so than I have been before. I never had an issue with consoles, I was just crap at them.

Kat: He didn't think we were, like, dirty console peasants or anything like that.

Doug: The PC master race!

Tom: No, no, I was quite happy with consoles.

JBW: See, I've looked at that and all the memes surrounding it but when I talk to people in person it tends to be more ironic...

Doug: Oh yeah, we just do it wind up the console kiddies.

This short exchange is fraught with the type of inter-platform cultural politics discussed earlier in the chapter (3.3.1). Kat interjects to defend Tom against a possible perception of him as a PC elitist, knowingly drawing on the language used in the online subculture, where "dirty console peasants" is used as the antithesis to "glorious PC gamer master race". Following this, Doug jokingly interjects with "PC master race!" before dismissing the self-aggrandizing label as just something to irritate the "console kiddies". At the same time, the use of the diminutive term "kiddies" does - despite Doug being a cross-platform gamer - gently reinscribe the perception of consoles as a less sophisticated platform, or at least one associated with a less mature demographic. Doug owns an Xbox 360 as well as his gaming computers, but suggests that each platform "has its own place", and that he now uses the console for the "snatches of gaming" available to him as a new father[33]. Elsewhere in the discussion, he highlights some of the practical and economic barriers to entry that keep PC-gaming (especially at LANs) an esoteric niche:

> Doug: While I still believe that you get a better experience out of a PC and the price of PC games is generally lower, the cost of the hardware to get it out of it is disproportionate to that, I think … I spent nearly two thousand pounds on a laptop, mainly because I cannot be bothered to drag a tower and a 24 inch monitor around the country to LAN parties.

For some of the LAN-party attendees - Doug included - the games at such an event were actually secondary to the experience of meeting and befriending likeminded "geeks". Danielle talks about gamers having had their "own little niche" or "camaraderie" separate from family-targeted casual gaming like the Nintendo Wii. She, like some of her fellow LAN-attendees, started PC gaming relatively recently but had played on consoles since childhood. For Danielle, having not enjoyed playing online console games with strangers, a scout-hut full of PCs was a preferable form of social play. Some participants located the appeal of LAN parties in a more generally hedonistic atmosphere, seeing them primarily as events where someone could "get drunk and have fun" while expressing a disinterest in the more competitive aspects of the event. Doug (40, network manager) contrasts himself with more competitive gamers in the following way:

> Doug: Because [LAN parties] attract similarly minded people, it isn't uncommon to find that it's a good way of mixing with those people. If you are of a slightly geeky nature going to a place where geeks are the norm rather than the exception is a great environment.

There is a logic to this social function of the LAN party; if most PC gamers are also console gamers, then PC gamers will most likely represent the most omnivorous and enthusiastic consumers of digital games. As Doug was quick to point out, many PC games are cheaper, with online purchasing platforms like Valve Software's Steam offering regular and sometimes quite extreme cut-price sales - something that was regularly discussed on the LAN party's online site. In addition, many smaller, independent games are released first on the PC

[33] Jesper Juul (2010, p. 162) similarly talks about the "ex-hardcore" player; usually older men whose gaming habits have become more "casual" due to developing family commitments.

because of easier distribution and the absence of financial barriers to entry into console markets. For the majority of the gamers interviewed, going to all this extra financial and physical effort to play PC games was not just about allegiance to a specific gaming platform, but a 'geekish' love of games as an entire medium.

More importantly, however, this group illustrate that those who gather at PC-gaming events are not necessarily PC exceptionalists or 'fanboys', despite the someone antagonistic tones used in online discourse around gaming platforms (3.3.1). While several of the IT workers I interviewed had personal histories of PC gaming, over half of the LAN-party attendees did not work in IT, so it is not necessarily the case that building and maintaining gaming computers guarantees either aptitude or interest toward IT-related careers.

3.4 Conclusion

Data analysis thus far has focussed primarily on participants' histories of technological use, the specific technologies they had access to earlier in life, and the affordances of these machines. The chapter followed a roughly chronological order of events, beginning with a historical account of the entry of computers into British homes, and the cultural context created partly by schools, industry and the government. The affordances of the platform itself - the "microcomputer" - were important to note, because the immediacy of the programming environment provided by the universally-implemented BASIC language meant that hobbyists active during the 1980s had a specific type of early hobbyist career in which programming was foregrounded. Existing literature on the history of home computing was interwoven with interview data to generate a discussion between the existing account and the respondents' oral histories.

During the 1990s, these machines gave way to more modular hardware and graphical operating systems which offered different learning affordances, as illustrated by the accounts of some of the participants who were too young to be active on the '80s machines. These accounts can be used to further illustrate what these historically-specific technological changes meant in terms of reconfiguring the relationship between gaming and hobbyist computing. Incorporating a reading of contemporary PC-gaming culture allowed some of the participants' gaming practices and preferences to be contextualized within broader tensions in gaming, as well as providing an account of some contemporary discussions occurring between and across platform fandoms. Understanding the subjective dimension of IT workers' gaming necessitated a discussion of how different gaming platforms are positioned in relation to each other, and how these relationships or tensions between platform-specific cultures are presented in prominent online websites and communities. Interviewees spoke about the values and beliefs they attached to gaming as a hobby and - in a small number or cases – their views about PC-gaming as a more serious leisure form with connotations of creativity and learning.

The cross-generational perspective taken here has highlighted change and continuity in the relationship between gaming and hobbyist computing since the 1980s. Understanding these relationships requires some attention to the changing nature of the technologies themselves, as different gaming platforms are shown to have afforded different types of incidental and informal learning. Acknowledging this allows us to better distinguish between the unhelpfully broad category of "gamers" and a smaller niche of hobbyist "gamer-tinkerers" who would later go on to build and/or program computers. The relationship between gaming and hobbyist computing

comprises of both materialist and attitudinal elements, which are interrelated and contingent upon each other. What remains is to relate these findings regarding early leisure careers to interviewee's professional identities as IT workers. This task will be the focus of the following chapter, which interrogates respondents' attitudes to their jobs, their perceptions of people who work in their respective fields, and the organizational cultures in which they work.

Chapter 4: Mapping Career Transitions from Hobbyist to Professional Techie

This chapter departs from the previous discussion of gaming and computing habits to focus instead upon computing as a professional field, drawing connections between participants' formative years, their current professional identities and the workplace cultures they find themselves a part of. Most of the discussion here centres upon programmers, although some of the dispositions described most likely have some applicability to those working primarily in hardware-related fields as well. For many of the research participants, the 'tinkering' activities occurring in or around a context of PC gaming were tacitly – though not always consciously – linked to the formation of drives and aspirations which continue to inform their professional identities as adult. As such, the type of informal/hobbyist learning happening alongside and through PC gaming is tied to notions of an archetypal "techie" who typifies how good IT workers should think and behave. As Ken Roberts (2009, p. 16) summarizes; "Bourdieu contends that when actors enter any 'field', which may be education of the labour market, those with similar cultural capital will tend to act in similar ways and recognize each other as people like themselves". The 'techie' can be understood as a technicity: a technology-related identity (see 1.2.1) which incorporates a set of skills but also, like in Bourdieu's concept of habitus, a set of dispositions. The development of such a technicity is closely bound up with material conditions of technological access and ownership, particularly during a person's formative years, and may have real consequences in terms of the degree to which an individual is able to enter the field of professional computing; to remain there and to gain status within that field. This chapter will focus on 'techie' as a shared identity informed by what I call an 'ethic of self-tutorage'.

4.1 The Ethic of Self-Tutorage

In their discussions of work and leisure, many of the participants evidenced what I have terms an 'ethic of self-tutorage'. This term describes the value and pleasure which participants attach to teaching oneself a set of skills through trial and error; and encouraged during childhood, usually by older male relatives. This includes a discussion of how such a disposition is advantageous to employers within the field, in the sense that they do not necessarily have to expend as many resources in formally re-training staff. As such, the ethic of self-tutorage can be considered a part of a habitus – a socially structured disposition which to some extent structures social action – which is conducive to obtaining employment and social status within the relevant field. The perception of computing tasks as interesting challenges - rather than frustrating chores - was part of the attitude shared by many of the interviewees, regardless of whether they were working as programmers or tech support.

What should be noted here, however, is how early these dispositions seem to arise in relation to computing. As previously noted, most of the hobbyists who were interviewed had begun either programming or building computers before their teenage years. This was true for the older

research participants who had access to microcomputers in the 1980s (3.1.2) as well as those in the following decades (3.2.2). This section explores the 'cultural fit' between interviewees as individuals with particular shared biographical elements, and the field in which they now find themselves working. As one would expect, these technical roles to some extent demand an affinity with technology. However, the relationship between individual dispositions and the prevailing institutional culture is more complex. For example, technical professions benefit financially from not having to train technical staff, even as the demands made of them change relatively quickly, and the hobbyist route taken by many of the research participants provides these employers with a workforce who seem, in many cases, happy to train themselves. After all, this is the way they have always learned, and this is particularly true for those young enough to have gone through the more recent UK ICT curriculum, where programming and hardware are barely touched before the age of 16.

4.1.1 Youthful Challenge and Self-Tutorage

Mark recounted that, following university, he had avoided taking up a career in software engineering out of a concern that this would destroy the pleasure he had derived from hobbyist programming since childhood - a worry he later discovered was unfounded. In the majority of cases, the perception of computing tasks as pleasurable challenges arises during childhood or teenage years and informs the respondents' understanding of who they are today. Consider the following quotations taken from separate interviews, all of which associate computing with the pleasure of overcoming obstacles:

> Neil: As a kid I enjoyed the challenge; the mental exercise; the challenge of solving a puzzle.
>
> Sarah: I don't like to be beaten. I won't let the computer beat me. It's like I am going to restore this computer, it is not going to die. I can't let them win.
>
> David: If you're driven by challenge then obviously you go home and you get on the computer and you're thinking what are you gonna fix next or what's the next thing coming up that you want to try … With these guys in here [junior staff] there's only so much you can tell them and until they see it for themselves or learn the hard way it doesn't stick. The only way they learn is by failing.
>
> Mark: The lecturer was standing at the front very smugly saying, "this is all about databases, you can't write a game in a database, so let's get on with some real work today". So I spent the entire lesson writing a text adventure game in a database … Never throw the challenge, because there's bound to be some smartarse in the back of the class!

Each of these accounts indicate a self-directed, challenge-driven approach to learning. These accounts of being "driven by challenge" suggest a high degree of self-motivation, stemming from the way the skills in question were acquired. Also note that all four of above respondents initially began programming at home; with Sarah acquiring her first computer the latest, during her late teens. Neil talks about "challenge", "mental exercise" and "puzzles" as pleasurable challenges in the abstract, before relating this back to his own orientation to

computers during childhood and beyond. Sarah is a software engineer, but speaks here about restoring a computer to working condition, which is more of a tech support activity. This in itself illustrates a sort of holistic view of computers as sets of challenges to be overcome; Sarah does not separate her abilities as a programmer from those related to maintaining the machine itself. David explicitly refers to being "driven by challenge" and goes on to reveal how his own hobbyist trajectory influences how he treats his junior staff. David's hobbyist background influences his practice as a manager of younger programmers; many of whom have been through more formal paths of education. Neil, Sarah and David describe the computer itself as the bearer of the challenge, whereas Mark describes a literal challenge from a "smug" authority figure.

The distinguishing characteristic of informal learning – such as that undertaken by these respondents during their earlier years – is that the psychological "locus of control for making decisions regarding the goals and means of learning" rests upon the individual, as opposed to any outside tutor (Mocker & Spear, 1982, p.1). This is particularly relevant in Mark's anecdote in which the challenge comes from a formal tutor and authority figure who has asserted that a certain type of programming outcome cannot be achieved. In the other cases, the internal locus of control is expressed in Neil's childhood love as programming as puzzle solving and though David's description of himself and some of his colleagues as "driven by challenge". In all cases, self-determination and trial-and-error (learning the "hard way") are presented as the best teachers.

Robert Stebbins notes that hobbyist learning is usually characterised by positive feelings emerging from "sticking with [the leisure activity] through thick and thin, through conquering adversity" (1982, p. 256). This indicates a kind of positive-reinforcement loop wherein the practitioner must seek out increasingly difficult activities in order to continue to derive pleasure from their hobbyist activities. These positive feelings may be amplified by the sense that the activity is difficult or requires a skill which is rare or unusual. For example, Max recounted being "chuffed to bits" with the performance of the first gaming PC he built, while many of his school friends would only have owned consoles, and would not have known how to build their own computer. Another of the younger adults interviewed – game developer Lee - described his earliest experiences with the QBasic language in the following terms:

> Lee: I think as a kid you feel quite special being able to do things that not many other people seem to know how to do. It just gives you a nice feeling which kinda makes you think "well I can carry on having this feeling just by learning more" and you just carry on doing it.

In this case, the self-determining hobbyist orientation – the love of the intellectual challenge provided by computers – is reinforced by outside perceptions. In Lee's case, this comes from comparing himself to school friends. As seen in Chapter 3 (3.3.2), the pleasures Max and Greg associated with hobbyist self-tutorage were reinforced by positive responses from family to what they were doing. The relative scarcity of a skill provides a feeling of "being special" which enhances the pleasure obtained from the leisure activity. This is a mechanism of social distinction; whereby skills and knowledge which are rarer are perceived as more valuable are awarded more status (Bourdieu, 1984). As discussed in the theoretical framework section of the literature review (1.2.6) computers can be understood as examples of objectified cultural capital, while the knowledge or dispositions required to use them are embodied cultural capital

(Seiter, 2008). The 'higher' forms of computer literacies – those which permit entry into the technical middle-class - hold a special appeal to some young people precisely because of their rarity.

For Bourdieu, social relations and cultural knowledge/objects are appropriately described through the economic metaphor of "capital" because they exist in a system of exchange. They are things which "present themselves as rare and worthy of being sought after in a particular social formation" (1977, p. 178). The last point is particularly important; particular social formations reward different types of cultural capital differently. From a Bourdieusian perspective, there is no inherent value to being able to use Microsoft Word or to be able to create Smartphone apps. Such activities are awarded different levels of prestige within our society based upon the perceived value of what the activities produce, but also upon the relative rarity of each skill. To take an example related to a different everyday technology; driving a car exemplifies a set of cultural capitals which are largely taken for granted by many people in Western countries. The knowledge of how to drive a car is an embodied type of cultural capital, while a driving license exemplifies what Bourdieu called "institutionalized" cultural capital e.g. a recognition by a societal institution through credentials or qualifications. Being able to drive is generally understood as a valuable skill, but its perceived value would increase were it to become more difficult to learn how to drive or to receive a license.

It is not only the knowledge of how to code which might constitute a form of embodied cultural capital. The rarity of computing knowledge, and the way possession of that may positively affect an individual's self-perception was illustrated by Lee's quote about feeling "special being able to do things that not many other people seem to know how to do". Such an attitude becomes advantageous in a profession where skills are updated constantly and often without formal training. A cultural capital becomes attached to being the sort of person who not only excels within the field, but who enjoys doing so.

Given ongoing public debates and policy interventions into the gender dynamics of computing and other STEM subjects (summarised in 1.1.3) it is worth noting that respondents gave varied responses in terms of whether they attributed the development of this sort of mind-set to nature or nurture. For example, one respondent equated this to a "typical male brain", while another said, at one point;

> Neil: I don't know how politically or factually correct this is but the programmers who more fit the stereotype of the bearded basement chap exhibit signs of autism because of the focus on one thing, and a lot of it's about spotting patterns as well.

Studies indicating a link between high-functioning forms of autism and talent in STEM fields include (Baron-Cohen, et al., 1997; Baron-Cohen & Wheelwright, 2001). Neil's perspective reflects an emergent school of thought in which autism is viewed as a personal resource (NPR.org, 2013; The Guardian, 2015). However, what is relevant here is not necessarily the objective truth of claims about the origins of some archetypal 'programmerly' mind. What is most important to note at this juncture is that respondents – many of whom had never met each-other – put themselves into a similar general category; a certain type of person who is often more object-oriented than people-oriented. As David put it:

> David: If you're into programming, it does turn you into a certain type of person I would say. I don't know about other people, but I find that I feel more at home there than maybe talking to people or, y'know, communication with human beings I suppose,

it's slightly less interesting [laughs].

Neil suggested that the stereotype of the hacker as "someone who hacks away in their bedroom, grows a long beard, eats nothing but pizza, wears shorts and sandals and lives at home with his parents" is a caricature rooted in reality, and that techies "tend to take life less seriously" and often have a disregard for money and for those dealing with the economics and marketing sides of the businesses in which they work. Popular stereotypes of techies as asocial and obsessive were, therefore, reinforced by some of the respondents' accounts. Indeed, the perspective put forward in sub-section 1.2.6 of the literature review characterised computing as a field which required a strong orientation toward things as opposed to people.

4.1.2 Self-Tutorage as Industrial Norm

Having identified the role of self-tutorage and 'pleasurable challenge' in respondents' biographies, it becomes possible to explore how this type of orientation allows them to enjoy a cultural fit with the prevailing culture in professions such as web or software development. Understanding some of norms in the professional field of computing helps to contextualise the previous chapter's findings in relation to IT professional's histories of game-related hobbyist learning. In a 2003 book about working culture in Silicon Valley, Alan Hyde notes the following:

> Programmers are hired for actual experience in very specific applications of very specific programming language, as we have seen and will see again. Firms do not retrain older programmers trained in older languages, but expect such individuals not only to retrain themselves, but somehow to get experience themselves. (Hyde, 2003, pp.86-87)

Although it is not necessarily the case that computing jobs in Britain should follow the same pattern, many of the research participants offered accounts of retraining themselves in different programming languages as they moved between jobs. Their histories of hobbyist learning make them well-adapted for the field in which they find themselves, due to this prevailing ethic of self-tutorage. A self-reliant attitude becomes advantageous in a profession where skills are updated constantly and often without formal training. Aaron describes the connections between how he began learning, and how he continues to self-educate as a professional adult:

> Aaron: Being self-driven helps a lot. The most difficult for me as a kid was trying to find like-minded people who not only knew what I was on about, but also were able to answer my questions in a way that made sense to me. Often I couldn't find such people, and therefore had to try to answer those questions myself. This has stuck with me since now. I still go out and try to find answers the "easy" way by asking people, or a search engine, but if I don't find what I'm looking for, I'll roll up my sleeves and get to work.

Aaron is not alone in this practice. For many of the interviewees, the perception of self-tutorage as a pleasurable activity does not wane with age. For many of the interviewees, the informal nature of their initial skill-acquisition carries naturally into their attitudes to programming as professionals. Time spent building and programming computers during youth allowed them to develop a self-directed trial-and-error approach, wherein small failures and emergent knowledge-gaps are a routine part of the work. The ability and desire to learn as they go, or 'on the fly', is present in their adult lives, and regarded as an industry-wide expectation for programmers:

David: I tell the guys I supervise that if you're not reading a lot in the week outside of this job, you're not being a professional programmer properly. They're free to do their own thing. but I say, whatever spare time you've got … I've got kids so y'know, sitting on the toilet is a prime time for having a book in your hand [laughs]. You've gotta be doing that as part of the profession. 'Cause it evolves quicker than you do as a programmer. You've gotta keep constantly searching if you wanna be ahead.

Mark: Once you're programming, what you find is you've got this weird situation that you need to be at the cutting edge. You haven't got time to be, and your job - which needs you to be at the cutting edge - also needs you to do the same thing over and over and over again, so you kinda have to take the initiative to use your own time to push your skills forward and then you can push that back into what you're doing. Then you can keep your skills current, so if you decide it's time to move on you think actually I've already got the skills I need to go to the next kind of job that I want to look at.

Neil: I went over to Java, did some of that, did PHP, Python, done a bit of C#[34] … I think just generally as things come up if I'm interested in it and I want to learn it I've never been on a training course to do it, I generally just get myself a book and read up about it online until I can work out how to do it, which is probably contrary to those who have been through a more formal education[35].

Cameron: It gets to the point where if you know enough about code, the language becomes somewhat immaterial. It's just sort of OK how do I do this in this particular language? OK cool I know that now, done. You know sort of what you want to do and its just looking up the specific syntax … there's a new flavour of the month way of doing X, Y or Z every week it seems so yeah, you really do have to keep up with it.

The theme of self-directed domestic learning is one which reappears in interviews with participants of various ages, and the preferences for this type of learning partly explains the prevalence of negative appraisals of formal IT training among this group of interviewees. In

[34] JAVA, PHP, Python and C# are names of programming languages.

[35] Note that in the first data analysis chapter, Neil's perception that the hobbyist route into programming had "died out" with the advent of university courses (4.2.2) stood contrary to the experiences of younger programmers like Lee, Cameron and Mark, who had attended university computing courses after and alongside hobbyist learning.

each of these cases what we see is a close cultural fit between what is expected in the field, and the subjective orientations these individuals enter the field with. Wain (1993, p.63) argues that informal learning involves not only the acquisition of skills and knowledge but also attitudes and values associated with a field – a point which applies here in relation to the ethic of self-tutorage connecting the dominant culture of the IT field with the leisure biographies of many of its entrants. As David asserted in relation to his younger colleagues, self-tutorage is considered an important part of "being a professional programmer properly".

The whole disposition towards enjoying challenge and tutoring oneself is, in itself, valuable beyond the knowledge of any specific programming language (although programming jobs are often advertised on a language-specific basis). As discussed previously, it is not just computer literacies themselves which operate as "cultural capital" - Bourdieu's term for a type of intangible personal currency which can be converted into money or status. Rather, the actual attitude to self-tutorage is a type of cultural capital in its own right due to its fit with the demands of a field where the popularity of programming languages changes relatively quickly. As such, those with a hobbyist background may have a particular advantage over those who - for example - are pursuing programming primarily to secure well-paid, high-status work. These accounts resonate with philosopher and natural scientist Michael Polanyi's (2009) observation that learning informally provides access to "tacit knowledge" – i.e. knowledge which is not wholly cognitive and must be felt. In this case, tacit knowledge is associated with a general 'mind set' belonging to the archetypal programmer; i.e. a person who does not simply know a programming language but is able to understand the logics behind computer programs more generally, and who relishes the challenge of gradual mastery of these logics.

This ethic of constant self-tutorage is also evident in how some respondents speak about an archetypal programmer. Several research interviews hit upon a belief in an archetypal 'programmerly' mind-set – a set of attributes and drives which make a "good" programmer. For example, Greg describes his earliest experiences with the BASIC programming language in the 1980s in the following terms:

> Greg: BASIC was what it said on the tin. It just gave you the flavour of the mind-set. It's like what play dough is to bricks and mortar. It could lead you into more low level programming in COBOL, FORTRAN or whatever else people used to use (I have never used these). C++ I started with. Now of course it's all C#.

From Greg's explanation, it appears that what was being learnt during his early Amstrad use was not necessarily a specific language which would later be applicable to work, but something more attitudinal – "the flavour of the mind-set" associated with programming. Here, it becomes possible to draw connections between Greg's earliest encounters with micros and his adult orientation to work. Cameron notes that, after coding in several languages, the specifics of each language become "somewhat immaterial". Similarly to Greg, Cameron suggests that the more visible skills associated with his profession (e.g. knowledge of specific programming languages) are secondary to a more general set of ideas about controlling computers.

Although an institutional and professional demand for constant self-tutorage outside of paid work hours might appear gruelling to an outsider, their early experiences have oriented them towards informal learning as a source of pleasure in itself. This brings to mind what Paul Willis (1977) observed about youth school-work transitions – where youth cultures foster a sort of continuity between the two settings. Willis uncovered the ways in which the anti-academic

roughness and rebellious physicality of working-class boys' culture fostered a kind of disposition which actually fitted with the demands of manual labour. We could argue that older respondents - "techies" like David, Mark, Greg, Douglas and Neil - represent a contrasting example not too historically distant from the "lads" and "'earoles" in Willis' study – but contrasting with the "lads" as an identity oriented around studiousness, self-tutorage and intellectual achievement - although occasionally still containing traditionally masculine emphasis on rebellion, as in Mark's account of making games on spreadsheets. The group of respondents did also contain one woman who had begun her career as a hobbyist on entering university, but unlike the men she did not place her hobbyist learning in the context of gaming - preferring to play consoles and to view her computer primarily as a work machine.

The pleasure which derives, as Stebbins (1982, p. 256) puts it, from persevering with an activity "through thick and thin" and "conquering adversity" is central to the hobbyist's perception of self-tutorage as something which is pleasurable in its own right. Given the need for programmers to constantly update their skills. This makes hobbyists a close cultural fit with the preferences of IT employers, who would rather their staff were training themselves, than invest in expensive training courses whenever a new programming language was required (Hyde, 2003, pp.86-87). When this is also part of an individual's disposition – for example through years of self-tutorage using books, websites and peer mentoring – we witness a fit between their habitus and the field. As a result, the ethic of self-tutorage can be understood as a defining characteristic of the field of work in question. This poses problems for inclusivity, because not all young people have opportunities to learn in this way, due to a lack of resources or support. Recent criticisms of the characterisation of young people as 'digital natives' who are naturally skilled with technology have argued that it is a minority of young people who are able and confident to learn this way; through trial and error (Kvavik, 2005; Margaryan, et al., 2011; Koutropoulos, 2011) for fear of damaging a computer or losing files.

4.1.3 The Parental Role

Something touched on briefly in Chapter 3 and in the existing literature, but not fully explored in the context of the data gained from these interviews, is the role of the family in the production of a 'computer geek' or 'techie' cultural habitus. The family home can be regarded as a key site where attitudes and literacies fostered, and this perspective is shared by feminist sociological perspectives on gender and technology (1.1.3) and more class-focussed Bourdieusian conceptual framework (1.2.6). The theoretical perspective taken thus-far is a common one within the sociology of gender and of youth transitions, namely that young people come to gravitate toward careers involving activities which they have come to subjectively experience as pleasurable due to patterns of early leisure. Parents, however, play a key role in determining the types of leisure available and permitted during the early years. The following sub-section identifies and analyses the role played by parental – or more commonly paternal – figures in the formation of the types of attitude and values associated with work in the field of computing. The subsequent pages discuss the effects of early hobbyist engagement with computing upon the participants' lifelong perceptions of computing and their perception of computing tasks as pleasurable.

Fathers are mentioned in over half of the adult interviewee's accounts of their earliest experiences with computers, while mothers are hardly mentioned at all, with the exception of

Neil's mother – the COBOL programmer. Game developer Mark remembers his dad buying his first computer, an Atari 800, while his colleague Jeremy recalls his uncle having bought this. Lee's interview indicates a slippage between talking about consoles and computers, which was not unique among the interviewees and even more common among the school-age respondents discussed later on;

> Lee: I think we either got a NES first, or my dad got a 486 PC and then at some point a Commodore happened. But I think that was like 3rd or 4th hand, but the main, I mainly used to love games on the NES but I never really understand them very well. I was never really good at them. But once my dad got the 486, that was like... that was a lot more fun with my dad showing me the DOS commands and showing me how to start up Windows and all that sort of stuff, and playing Doom and um I used to like Paint, I used to just go on it and just paint things in Paint and just draw, draw like… guns and stuff.

In the previous chapter, Max (24) and Greg (39) were examples of PC gamers who also worked in IT roles, who both cited their fathers as the root of their own hobbyist interests. Max's father ran a tech company, allowing Max to get new PC parts relatively cheaply during the early years of the 2000s, while Greg's father started a PC parts company in the late 1980s:

> Greg: Us boys were spoiled. Dad bought us the Amstrad from the first batch that landed. Maybe he knew it would serve as a solid foundation for the rest of my life. He's never been into programming of any kind, he's a salesman. He ran his own PC parts/build supplier company for a while. Dad's always been a fan of gadgets and toys even though he thinks all games are a waste of time and bought these consoles/machines for our entertainment… Dad started building machines somewhere around 1986 / 87 and it wouldn't have been too long afterwards. We knew about hardware early as we lived around it, Dad worked from home running his PC business so there were bits all over his converted garage. He built our first PCs but we knew what was going on inside them, new about the latest Roland Soundcards, knew about the exciting new VGA 256 colour ranges, the difference a soundblaster would make over the PC internal speaker etc. Probably around about early in secondary school I was doing it more myself, both my brother and I knew what we were doing probably about age 12, I guess?

While Greg and Max's fathers both worked in computers, other interviewee's fathers worked in technical roles which would bring them into contact with computers in the 1980s and early 90s, when home computers were less common. For example, Aaron's earliest memories of computers were spending time on a computer at a music producer's studio, when his father was there selling audio equipment. Game developer Mark said his dad "used to be a radar tech engineer for the RAF so there's always been a lot of tech in the house" illustrating the point made earlier (3.1.1) that computers during the 1980s were seen as an offshoot of older forms of hobbyist electronics. Similarly, web developer Cameron remembers, as a small child, "learn[ing] the order of keys on a qwerty keyboard before any of the alphabet" from sitting on the lap of his father; then a network manager, and cites his father as his inspiration for studying computing at university.

In some of the interviews, parents were described as having little technological knowledge, but providing the resources for the interviewee's to follow their chosen career,

including Sarah's account of her parents "making themselves poor" to afford her first machine for her design and engineering course at university. Ewan remembered a friend "whose dad was an illustrator who did a lot on computers". A central theme in Bourdieu's understanding of social class is that class is not solely economical (see 1.2.6) and the same is true for entry into the technical middle-classes. While several of these stories speak of the need for economic outlay, money is not necessarily always the primary barrier. For example, game developer Nigel recalls that his dad "rescued" his first PC "from a skip" and that this "was the first time we'd ever had one, so it was the magical box in the corner". Kat, a trainer at an educational software company, also recalled her dad "rescuing" a "crappy old" computer that was being thrown out at his workplace. Ergo, it was not necessarily money that the key requisite to early adoption. Rather, those who worked in close proximity to computers were more likely to see their value than, for example, parents in manual jobs with higher wages, a point also made by Ellen Seiter (2008) in her research in American schools.

Given that the existing literature suggests social class as a key mediator of parenting practices, computing uptake and PC-gaming preference, it is important to contextualize these paternally-themed findings in the broader discussion of social class (introduced in 1.2.6). Sociologists of technology such as Itō and Seiter have noted some commonalities between traditional middle-class parents' encouragement of computer-based learning, and the way this social group has, in previous generations, encouraged studious self-development activities. It may, however, be helpful to consider the highly technologically-literate as a specific class[36]. The BBC's Great British Class Survey, whose results were discussed by Savage et al. identified seven new social classes in Britain, one of which was the "technical middle-class" (discussed previously in 1.2.6). This label describes the professions fulfilled by the adult research participants, and in many cases their fathers. Overall, this class grouping was described as "a group of scientifically and technically oriented people who have used their skills to gain reasonably secure and well-rewarded work, but who might not be seen as part of a more established middle class" (Savage et al. 2013, p.237). Savage (2000) argues that the latter part of the 20th century saw the emergence of this new group who were differentiated from the traditional middle class, which was more oriented towards traditional arts and humanities. The survey found this class to be geographically in the South East of England – perhaps relevant given that this was the location where this research was conducted. The group also, according to Savage and colleagues, "shun the centre of London and tend to be located in suburban locations (perhaps consistent with their social isolation?)" (p.237).

As Elisabeth Hayes (2008, p. 223) describes in her study of young peoples' gendered gaming preferences, "centres of expertise" develop are usually structured by an initial personal interest and social interaction with other interested parties. These experiences must usually involve the support of enthusiastic and/or knowledgeable adults who scaffold the child's expertise by providing resources and experiences. Using the Bourdieusian inductive understanding of class applied in the Great British Class Survey, we can begin to piece together an image of class-reproduction within the 'technical middle class' described by Mike Savage and colleagues (Savage, et al., 2013; Savage, 2000). The purposively-sampled groups used for this research indicates that many (predominantly male) tech workers have, since the 1980s, encouraged their children to take a higher-than-usual interest in home computers from an early age, an example of the type of domestic cultural reproduction mentioned by Ellen Seiter (2008).

[36] See 1.2.6 for a discussion of inductive vs deductive models of social class.

‘Cultural reproduction’ describes the processes by which families retain some sort of social advantage - for example in education - by transmitting embodied types of knowledge from generation to generation, with the effect of making children and young people appear naturally gifted in the area in question (Jenks, 1993, p. 12; Bourdieu, 1986, p. 48).

4.2 ‘Techie’ as a Shared, Relational Identity

The self-label ‘techie’ indicates an affinity with technology and an association with a specific class faction composed of those in technical professions. However, techie can be understood primarily as a relational identity – that is, an identity which depends upon a distinction between oneself and a perception of others as ‘non-technical’. As Martine Burgos (1988) notes, biographical narratives are useful for identifying how individuals define themselves specifically in relation to others. In the accounts of school, several of the research participants bemoaned the type of computing education they received, while perhaps paradoxically illustrating why they had no need for any such education. In relation to their current workplaces, they complain about the technical abilities of others, particularly non-technical colleagues or clients, despite their continued employment or at least the high-status of their jobs being contingent on the rarity of their own levels of technical expertise. By tracing a thread through accounts of both school and work, it is possible to identify how techies characterise themselves as bearers of superior knowledge in both life stages.

4.2.1 Computers in School and Teenage Resistance

Carter (2006) argues that one of the key reasons why high-ability young people often disengage from ICT lessons is that their informal learning often surpasses what is being offered in the school curriculum. Cameron describes his IT lessons during the late 90s to early 2000s as “just Excel 101” – a criticism similar to those often made of British ICT education, outlined in the literature review (1.1.5). Cameron’s older colleague, Travis similarly derided his computing education nearly two years earlier as “boring”. 41-year old Jeremy said that the Logo program “nearly put [him] off computing”. This was not the case for all participants. Nigel, a 26-year old game developer spoke fondly of computing at school and of the summer-job he had working on the network during his A-Level studies. Many of the respondents held equally negative views about formal ICT education. The students would often complain about earlier courses having been too limited and simple, while adult professionals perceived a disjuncture between what was taught in school and the skills they saw as valuable in real tech jobs.

> Danielle: We were never offered computer programming. Actually the IT that we were offered; the IT lessons weren’t really... didn’t really push the boundaries of it.
>
> Tom: One of the things with education is it is very Microsoft-focussed. They really focus on the Microsoft platform.

Many respondents who went to school following the mid 1990s commented on the dominance of the Microsoft Office software package in the formal ICT education they had received. Among younger respondents, the software-centric nature of GCSE courses was criticised "it was just doing spreadsheets all the time" (Patrick, 16); "this is how you make a Powerpoint. Very basic, basic stuff..." (Dom, 16). Older respondents' negative opinions conveyed a perceived need for ICT education to provide very specific skill-sets for industry. In these cases, recent ICT courses were decried as "nothing to do with computing" (Aaron, 30) as being "rubbish [with] no relationship whatsoever to the programming or computer science industry" (David, 41) and as failing to "scrape the surface" in providing "office skills" with "nothing to do with IT" (Doug, 40).

However, it was also difficult to identify any consensus among respondents as to what computing/ICT education should contain in place of the ICT curriculum dominant throughout the 1990s and the first decade of the 2000s. What was perceived as missing or lacking from a computing or ICT course varied wildly between respondents. Among the adult professionals, opinions about which skills were appropriate or useful to teach seemed to be constructed retrospectively from a professional role the speaker now occupied. Doug, who maintains the hardware and software of a secondary school's computer network, stressed a need for a holistic approach to computing education, which begins with the machine's physical hardware and works inward toward the level of the operating system and only then onto uses of software and the Internet. Software developer Neil, however, argues that the goal of understanding the computer holistically was only realistic during the early years of hobbyist computing, and has since become untenable as computers have become more complex. David, who also works primarily in the production of computer software, focussed on the importance of programming.

Even among respondents who had undertaken ICT more recently, proposed alternatives to an MS Office-centred curriculum showed marked differences. Chael the 29 year-old graphic designer complained that ICT delivery was "dry", "unimaginative" and that its focus on office and business applications "didn't truly capture what's cool about computers". In his view, the computers' appeal lay in its ability to create multimedia. In contrast, Danielle – aged 24 and a data manager – had criticised ICT at her school for lacking any programming and – in contrast to other respondents' complaints – any work with databases. These two extremes exemplify unmet educational expectations which are very different. This diversity of expectation and interest is already catered to in some national curricula which – as in Australia – split ICT into two separate disciplines; one oriented around data management and programming, the other around multimedia applications of software. Although this more specialised approach to computer-based subjects has been criticised for channelling children into technical or creative applications of computers on a gender basis (Abbiss, 2009), Danielle and Chael show atypical orientations with regard the masculine gendering of technical ICTs and the feminine gendering of creative and/or social ones. What is most noticeable about the majority of these accounts is the sense of continuity between youthful hobbyist uses of computers, eventual career paths, and what was perceived as "missing" from formal education.

It may be tempting to use such accounts as evidence of some failure of school IT curricula. However, it is more in keeping with the present study's focus on social identity to examine such claims in more subjectivist terms. From an attitudinal perspective, expressions of what formal education lacks – or should contain – illustrate the speaker's personal beliefs about technology, education and work. Rather than being purely reflective of the education system's shortcomings, these accounts illustrate how the interviewees define themselves in relation to

others. As Martine Burgos (1988) argues, the possibility of uncovering these types of relational identifications is a key strength of biographical inquiry.

Dissatisfaction with the way computer skills were taught in schools was often expressed through accounts of using school machines in unintended ways. Cameron explains that, before his IT education got "vaguely interesting" at post-compulsory level, he spent a lot of his class time making flick-book style animations in Microsoft PowerPoint. With the love of computers as an inherently pleasurable tool comes a tendency to want to "get one over" authority figures who are viewed as less computer literate. For example, one designer offered a much more extreme (and graphic) example of a school prank which served to undermine teachers' knowledge of computers;

> Chael: …all people used to do was mess about, so we'd get the careers software and go into the pictures folder, and all the clipart pictures that were there, there was like a cowboy feeding a horse, well we took it into paint and we changed it so that he was getting head off the horse and that, and we uploaded the picture so it would load up in the software… we changed it so anytime they were doing a careers session there was like, bestiality and swastikas, well, we, we just went through the software checking out all the jpegs and that, and if something looked funny and could be tweaked and like, anything involving animals or kids it was… they did twig but after that I think the careers stuff there got phased out

Gaming in the school can also be interpreted in similar terms; as a resistant act. The installation of software by students is usually not allowed, and the use of such software (especially when counter to the prevailing school ethic due to violent or obscene content) is viewed as complicity with its installers;

> Danielle: In secondary school we had, like, the standard IT classrooms and my form room was also an IT classroom, and I remember some clever dick had put Quake 3 Arena onto the network, and [begins laughing] Kat's nodding so I'm assuming that this isn't the, y'know it happens quite often ... But yeah, so I remember at form time we'd all log onto the PCs and we would try and play Quake 3 against each other before someone clocked it and deleted it from the network.

Yuri (18, ICT student) tells a similar story, but one which highlights slight technological shifts when compared to Danielle's. Yuri and his friends would bring Warcraft 3 (2002) into school by pre-installing the game onto portable pen-drives. The game software could be run directly from these data-storage devices without being placed onto the school network. Alternatively "you could drag it onto computers and it would still work, so if someone shared their account, more people could play". Six years before, at Danielle's school, portable drives were less common and smaller user-profile allowances meant installing directly onto shared network space was the only option. As previously noted in 4.2.2, web developer Ewan recalls his attempts to access disallowed software and relates this to his overall career trajectories.

> Ewan: I don't know if this field attracts a certain mindset though, coz when I was in

school and on the public machines in there the first thing I was trying to do was why can't I play Minesweep? Why won't you let it let me have Paint?

Laughter is a common feature in the telling of these stories. These stories of technical subterfuge can be interpreted as expressions of confidence in one's own technical ability; of 'getting one over' on authority figures and the school institution, by undermining and exposing the limits of school staffs' expertise. When speakers call into question the competency of their past teachers, they are making statements about the sort of teenager they were; an early adopter, an independently-minded person whose expertise - often informally gleaned by 'messing about' at home - was greater than that of the teacher who was supposed to know more than they did. This inversion of the traditional teacher/student power/knowledge relationship is particularly noticeable in the following extract, where the interviewee, Ewan, recounts having to "teach the teacher":

Ewan: My school, they didn't even do GCSE computing. We didn't have a teacher capable of teaching it, we only done the one below GCSE I can't think what's that's called now? … But it was a Welsh school y'know, so I don't know if that had anything to do with it but I'll never forget I showed the teacher the autosum button in Excel and she was like 'oh my god you don't have to type it in yourself'.

While more spectacular accounts of computing culture emphasise practices such as hacking (Levy, 1994) these examples illustrate how computer expertise can be acted out through more subtle forms of rebellion. These stories may tell us about the shortcomings in recruiting policies at specific times and places, but are more productive as part of a discussion of the respondents' identities and how they conceive(d) of themselves as experts, both then and now; as examples of biographical narrators defining themselves in relation to others (Burgos, 1988; Bourdieu, 1985) and expressing a type of morality or intellectual superiority (Goffman, 1959; Bourdieu, 1984). These statements are multi-faceted and complex, in that they contain both the remembered judgements of teachers – judgements made at specific times during adolescence – but also a present professional judgement of another professional i.e. the remembered teacher. 'Incompetent teacher' stories serve to position the speaker as comparatively more adept in two historical locations; both as the present teller of the story – an adult computing professional capable of making such a judgement – and in the remembering of their younger self as someone capable of manipulating school computing resources to either antagonise or mentor staff and/or fellow students.

4.2.2 Relationships with Non-Technical Colleagues and Clients

These comparison stories, as performances of competence, are mirrored in some of the more negatively-toned accounts of dealing with people in present day-to-day professional interactions:

Ewan: … One of the clients inquired to me as to why the animation wasn't working on their .gif when they printed it out.

Sarah: Clients just need slapping. The clients, they're what ruin websites. I can build a beautifully coded site and then they get their hands on it.

Kat: I work for a computer software company for educational software; I train teachers on the program …We get a lot of technophobic teachers as well which is great fun to work with.

In the above cases, research participants treated interviews as an opportunity to vent frustrations arising from having to deal with a knowledge gap between themselves and their business clients. These sentiments are further examples of an anonymous piece of writing circulated on the internet, titled "If Architects Had To Work Like Programmers" which hyperbolically describes the frustrations of working with non-technical clients who make unrealistic and constantly-changing demands. In some cases, the irritation with the less technically literate is aimed more at what is perceived as a wilful ignorance, summarized in the geek acronym RTFM ("read the fucking manual"; Neil, 38). In others, Neil explains, it can be a sort of performance. Neil, for example, notes the terminology "geek antlers", used frequently in online tech communities to connote a sort of intellectual sparring. The mockery of the less skilled - which is often tongue-in-cheek but nonetheless present - suggests that some techies view computer skills as something which everybody should possess. However, it is this apparently frustrating knowledge gap which enables respondents' professional roles to exist, as is the case with any specialised technical profession. Identification with the "techie" label also depends on this sense of difference; a perception of the self as a possessor of something valuable; something which the less knowledgeable do not always understand the value of.

Within biographical research, the positioning of the self as a moral actor is considered to be a common part of everyday discursive practice, serving to present the speaker as a moral actor, or as Erving Goffman described, attending to the social "obligation and profitability of appearing always in a steady moral light" (1959, p. 244). The implication of Goffman's claim about image management is not that statements about the self are always consciously contrived, rather that the maintenance of an image is something that most people do constantly and often unconsciously. For example, while Sarah's claims about clients who "need slapping" might seem harsh when read out of context, characterising clients as unreasonable and/or poorly informed works to present the speaker as long-suffering, hard-working and tolerant. The implication of Sarah's claim is that the clients have not actually been slapped, despite such an action being somewhat justified. As such, through relating the difficulties of being in a technical role and working for the non-technically minded, respondents position themselves as moral actors in terms of these desirable traits of tolerance even if the expression seems to be, at face value, condescending mockery.

Some of the interviewees also offered accounts of "pranks" which tell us something about the informal culture of some tech workplaces. In some cases, these pranks revolved around putting content into the code of a website or piece of software which would be undetected. In the following exchange, my own question about transgressive elements of programmer culture is met with a set of expositions which span the life-course. Cameron begins by talking about "running rings around" school teachers, which prompts Travis to talk about "letting off steam" through "mischievous office humour" in the form of informally or absurdly phrased commit messages, which are normally meant as a running log of changes made to a piece of software or website as it is being developed:

JBW: Have you noticed any sort of aspect of rule-breaking, cheekiness et cetera in programmer culture?

Cameron: Well, particularly in schools I think so, like, it might have something to do with the age you are, you're always looking to sort of one up them. But also because I think you can generally tell if the teacher isn't that competent, and it's just sort of, I can run rings 'round you.

Travis: I think there's a little bit of mischievous humour in the office at times as well ... Sometimes it really helps to relieve the pressure just by doing something stupid. It'll only take 30 seconds to write something stupid as text.

Cameron: Yeah ... at one of my old jobs they'd shipped a piece of – no, it didn't ship, it went to testing, to like a beta test in like a hospital because they wrote software for the NHS, and there was an error message that had slipped through and it was just a picture of a screaming baboon and it said oh god everything's gone to shit! or something, and some poor nurse who'd been using the system caused this error and it just slipped through the initial quality assurance phase…

Travis: Yeah, you're releasing a bit of pressure by doing this stuff, but it's even before it gets shipped, you have to be careful what gets committed, into version control especially some of the clients are on the same repositories and you have to do a double-take sometimes when you're doing your commit messages…

Cameron: Yeah, funny commit messages is another one. I've got some repositories where the commit message is like I don't even know what this is… you write a little sort of summary of the change you made and why you made it and everything, but some of them are just like, y'know just don't touch this bit of code, I don't know what it does [laughing] but if you go near it it'll break.

This collective account somewhat confirms Neil's earlier suggestion that a tension often exists within businesses, where non-technical management staff perceive techies as "unprofessional", "goofy" and as "cowboys". In Travis' account, this type of informality acts as a type of pressure release valve in such workplaces, and efforts must be made to maintain a boundary between this informal "techie" office culture and the expectations of non-technical colleagues and outside clients. Cameron's anecdote of the "screaming baboon" offers a window onto a mischievous part of techie culture.

Cameron begins talking about pranks at school before the conversation moves onto the culture of similar pranks in the workplace he currently shares with Travis. This illustrates how themes are implicitly linked throughout participants' biographies in the act of telling. For example, it is possible to link these 'goofy' pranking office behaviours to earlier experiences of computer use during school years (4.2.1). Both types of story share similar themes; the highly computer literate narrator is shown to "run rings around" or "slip one past" educators during adolescence, just as they occasionally do with their colleagues or clients today.

These hidden messages are usually referred to as 'Easter eggs'. Easter eggs exemplify a thread of "defiant programming" (Temkin, 2003) within tech culture. This practice is 'defiant' insomuch as it surreptitiously injects informal or subversive content into otherwise high-quality commercial products. Some of the most widely known examples of Easter eggs are those left by game developers, such as the controversial 'Hot Coffee' sex mini-game in Grand Theft Auto: San Andreas (2004). But there also numerous examples of Easter eggs in more mundane software. The web browser Mozilla Firefox contains a hidden "Book of Mozilla" entry written in the style of apocalyptic prophecy, while the Terminal program on most Apple Macs contains a secret text-based program which mimics an artificial intelligence acting as a therapist. These are examples of Easter eggs which are widely known and shared via the internet, but the case of the 'screaming baboon' provides a more everyday example of this kind of practice. While Travis explains ridiculous or borderline offensive hidden messages in terms of "blowing off steam", the cathartic aspect of this sort of practice no doubt arises from imagining the intended user eventually finding what was left – a performative type of risk-taking traditionally associated with competitive masculine culture.

When complaints about the ineptness of both clients and teachers are considered together (as in Ewan's case) these parallel themes of school and work bind the past and present in the biography, illustrating how the geek identity is constructed in terms of difference. Being a computer geek is not simply about possessing technical knowledge, but about a particular attitude to that technical knowledge.

Firstly, that pranks (both in the office and the classroom) function as a way of "letting off steam"; a pressure release valve during periods of frustration, but also as a way of performing expertise and superiority through mischief and subterfuge ("getting one over" on an unwitting teacher or client). If talking about incompetent teachers or clients positions the speaker as an expert through discourse, then challenging their authority through pranks and illicit software installations is an act of positioning through praxis. In these cases, "geek" comes to represent a studious or hardworking but simultaneously anti-authoritarian identity which works within dominant power structures (e.g. the school, capitalist enterprise) while denying total compliance through small acts of subversion.

In contrast to these narratives which mock teachers in the past and clients in the present, some respondents lay claim to expertise through stories which emphasise helping. Here, the earlier theme of comparing one's own ability to others is paired with a new theme of helping others. This is apparent in Ewan's account of teaching his teacher to use Excel's "auto-sum" function, and also in Paul's (17) explanation of the "IT stuff" he does in his spare time, which includes "… helping people with, like, fixing their computer… changing boards and stuff." This theme is particularly noticeable in the biography of Doug (40), who organizes PC-gaming LAN-parties and is the network manager at a school. The following excerpts illustrate two examples of helping; one during the early stages of Doug's career as a computer "geek", and concluding with more recent interactions within the secondary school at which he currently works;

> Doug: Going back from the earliest days I was actually effectively network manager at a secondary school when I was about 17. My mum was appointed network manager at my school. She was already a teacher there and she wasn't really a computer literate person. I sat down, I read the books, learnt everything from scratch so for the last two or three years I was at school [laughs] I was effectively running the network.

Here we are presented with an extreme example of the position of the teenage past-self as already having been an expert. As with the earlier examples which link past experiences of teachers to recent interactions with clients, this flows into a more recent anecdote which, in this case, is focused around Doug using his self-efficacy to help others, while maintaining a level of criticality about other adult professional's lack of technical knowledge.

> Doug: We have a child in our school who's got to year 9 or 10 now, she'd been given a laptop because she had accessibility issues. She's constrained to a wheelchair, and, she has problems with fine motor control and therefore using a pointer was difficult. She came in one day and I said 'has anybody considered giving you a trackball rather than a trackpad? Let's try a few different things out here. Also, by the way if you want to get to this, try just pressing the Windows key and then typing the first few characters of what you're trying to find' and she was like 'WOW'. And like, if you want to close down a program, Alt F4. if you wanna copy, Ctrl C'. She can handle that far better than she would the trackpad. How had it taken that long for her to get to a point where she was told something like that? She wasn't exposed to us as geeks. The school has an SSWB department, Student Services and Well-Being, headed up by our SENCO [Special Educational Needs Coordinator], and uh, y'know they are vaguely aware that there are technologies out there. But the number of times I've had to go to them and say, y'know, 'why haven't you tried this, why haven't you tried that'…

In the second excerpt, the department in question are depicted as failing to properly fulfil their role due to a lack of knowledge about available technologies. In this case, Doug makes a claim about the superiority of his informal engagement with technology - which is based on personal interests - over the more solely work-oriented approach to technology typified by the SSWB department. From this perspective, his "techie" knowledge is positioned as superior because members of the SSWB department do not actively seek out technologies which may be of great help to the students using the department. From Doug's perspective, the SSWB staff's comparatively shallow engagement with the world of technology makes them unable to appropriately fulfil the needs of the student in question. Throughout Doug's narrative (as in the earlier example about teaching elderly community members) he speaks from a seemingly altruistic position of wanting to help others, which softens any elements which might potentially be interpreted as condescending or elitist.

As with earlier examples, computer literacy is presented here as something inherently valuable which is too often under-valued by many adults. In the case of Doug's second excerpt, the refusal of technology by non-geeks has concrete negative effects in the social world; preventing a school pupil from accessing technologies which would make her school experience easier. Although the tone and content of Doug's story seems less confrontational than earlier negative accounts of professional clients, both foreground the rarity of computing skills among adults in non-technical roles.

The previous subsections have explored how techies construct and perform their identity in a relational sense, insomuch as their self-identification as techies often depends on how they relate to non-technical colleagues and members of the public. Taken together, these various threads hint at a sort of paradox inherent in the subjective experience of technical employment: the techie values the skills they have, while depending on a lack of these skills elsewhere for their professional existence. To use Neil's metaphor of the computer as a car, that there are "people who want to drive fast and people who want to know what's going on in the

engine" - the latter group representing techies. While techies do not necessarily expect others to know everything, certain technical faux-pas are offered as stand-out examples of non-literacy and considered moments worth sharing with the interviewer and other interviewees, such as not knowing useful keyboard shortcuts, expecting an on-screen animation to print onto paper etc. Such expressions can be viewed primarily as a way of expressing a common identity – something that is particularly true in the case of some of the group interviews.

4.2.3 "Never Trust a Programmer in a Suit"

Assumptions about what engineers or technicians should be like may have consequences in terms of cultural 'fit' within the workplace and the industry as a whole. A technicity – a social identity grounded in uses of technology – can incorporate a certain type of subjectivity or shared worldview which is - in some cases - an assumed prerequisite to group membership; for example, in terms of how 'computer geeks' perceive the group of which they are a part. Such assumptions of intersubjectivity are most clearly apparent in respondents' descriptions of an archetypal 'programmer's mind', indicated earlier by a widespread perception of programming as inherently enjoyable to some people and of self-tutorage as a necessary aspect of "being a programmer properly" (4.1). However, questions of cultural 'fit' apply not only to the industrial expectations explored in the previous section, but also to more subtle distinctions such as sartorial style and brand preference. As David Schwartz (1997, p. 6) summarizes Bourdieu's understanding of socio-cultural distinction; "All cultural symbols and practices, from artistic tastes, style in dress, and eating habits to religion, science and philosophy – even language itself – embody interests and function to enhance social distinctions." How an individual presents themselves visually is necessarily a type of social sign denoting belonging to particular groups.

Just as many tech experts have learnt their skills through informal means, so they often seem to associate informality with expertise. Just as they define themselves in relation to non-technical staff and colleagues on the basis of knowledge and ability (4.2.2) they also see connections between their identities as technical staff and other aspects of their shared identity. This is apparent in Neil's broad statements about programmers "taking life less seriously on average" and having a "disregard for money" which sometimes places them in a tense co-existence with non-technical (i.e. business-oriented) colleagues, and often drives their engagement with open-source development outside of work. This orientation is also visible in many techies' attitudes toward sartorial style. In the above section, for example, Neil describes a dated but still true (in his experience) stereotype of a scruffy, bearded man who programs at his parents' house. The perception of techies as generally scruffy is prominent within Western popular culture. For example, in 2014, Wired magazine ran an article which was self-depreciatingly titled "The White House Gives Up on Making Coders Dress Like Adults" (Wired.com, 2014). In one group interview between techies at the business centre, a discussion about dress-codes emerges. This illustrates a congruity between individual fashion tastes, and the informal dress-code of the workplace itself;

> Ewan: When I started work I was convinced my first paycheck was gonna go on a suit and I just wanted to come in suited and booted all the time, and I do my best now

but we're very casual.

Sarah: I just remember my mum saying to me years ago 'you can't be the eternal student forever'. She was wrong.

Ewan: [laughing]

Sarah: I just can't be smart. I just can't do it. I don't do dresses. If I need to be smart I have to take my sister out to dress me. I love rubbing it in to people that I have pyjama Wednesday. When they all get together and they're all bitching it's like 'well actually I really like my job I'm really happy'.

Ewan: At my previous company they have company socks. That's how corporate they are.

Sarah: I'm lucky if I'm wearing matching socks.

Sarah's explanation that she doesn't "do" dresses reiterates themes of 'tomboyism' identified in Rhiannon Bury's (2011) biographical research with female IT professionals in the US. However, in the context of this conversation, the refusal of dresses - quickly following Ewan's discussion of suits -could be interpreted in relation to a less gender-specific notion of smartness. Dresses are offered as a gender-specific example of smart office wear, and contrasted with pyjamas - smartness is the central theme of Sarah's talk. While the lack of office dress-code is presented as a perfect fit with Sara's personal preferences, Ewan describes this informality as challenging his initial intention to come to work "suited and booted". Given the low number of female participants in this study, it would be both incorrect and unfair to treat Sarah as representative, but in this case her experiences and expressed worldview match up with several of her male colleagues.

Some of the interviews offer confirmation of the computer geek stereotype described by Neil. The archetypal programmer is usually imagined as someone disinterested in outward appearances. What we also see here, and in broader discourses surrounding tech work, however, is an institutionalisation of this identity in some tech workplaces. This exemplifies, in Bourdieusian terms, a fit between the cultural field itself - in this case the normalized institutional practices of tech workplaces - and a type of habitus or a set of dispositions - the 'computer geek' identity. As one of the teenage students would later tell me, a career specializing solely in IT was unattractive partly because the school's IT technicians "all sort of look the same"; glasses, unfashionable hairstyles and semi-casual clothing.

While techie spaces may remain predominantly male, it is worth noting that the mens' business suit is also frequently absent or even shunned, reserved for the "business and money people" who are only tangentially connected to the tech department and sometimes spoken about with contempt by the interviewees themselves. While Sarah's rejection of dresses could be read in terms of female computer geeks needing to abandon traditional femininity to "fit in", another interpretation is that the geek disposition is actually at odds with any overt gender expression through dress, including the corporate masculinity of the suit; the beard of the stereotypical loner-coder being the product of a neglect of visual appearance as opposed to the deliberate maintenance of a visual gender identity.

The above points about visual appearance resonate with similar rejections of branded technologies which could be interpreted as outwardly 'showy' or superficial. For example, Sarah suggests techies tend to prefer Android smartphones and tablets whereas "flashy marketing people" will be seduced by the sleek, user-friendliness of Apple products. For Sarah, there was a clear divide at her workplace between the coders and the designers who existed to make their work "look pretty" for clients. For Sarah, design work was "a very painful process … like pulling teeth". Attitudes to work, dress and technology itself generally held style as subordinate to function. In a separate interview, David makes similar connections between programmers and utilitarian aesthetics, jokingly contrasting computing with the 'sexy', brand-sensitive world of marketers:

> David: It's not brand oriented. It's not sexy to be in computer science, is it? Let's be honest. It's a box and wires and it's brown and beige and whatever, and we all care what's inside it, not what it looks like from the outside. It might be horrendous looking from the outside but it might be a super-computer inside.

David's story hints at a popular perception of his field as "unsexy", but it also underscores a belief - expressed by several participants - that institutional formality and visual presentation function as surrogates for concrete skills. Words like 'flashy' and 'sexy' speak of social pretence – of clothes or technologies fulfilling roles that have to do with interpersonal communication as opposed to utilitarian functionality. At first glance, it could be suggested that geeks value function over form and substance over style, but a sense of style is strongly evident in matters of coding, of the 'elegance' of how a program is constructed. A sense of style is present in programmers' discussions of their work as a craft. Style is displaced from the physical/material realm and into the computer itself, disassociated from the body and understood instead as the product of skilful practice. This is evident in Sarah and Ewan's expressions of their own perfectionism, as well as David's complaints of junior colleagues who "hurry too much" and subsequently "break" programs.

It may be the case that, for many techies, expertise trumps smart dress-codes and managerial jargon in terms of importance, perhaps so much so that scruffiness becomes a type of visual shorthand for the possession of computing skills and knowledge. As argued in the theoretical framework put forward in the literature review (1.2.6) computing can be understood as sitting at the "things" end of a sliding-scale between "people" and "things"-oriented work. Following Margolis and Fisher's work on gender and computing (2003) Roli Varma (2007, p. 363) has questioned whether the stereotype of male computer geeks as asocial and unfashionable is one of the factors deterring women from taking up computing. Varma notes that while women had made considerably more headway in medicine and law, both of which are previously-male dominated professions which are viewed as "smooth, cultured and highly socialized" in contrast to computing; which is associated with a lack of sociability and a rejection of sartorial style. As Neil put it in one of our follow-up emails; "never trust a programmer in a suit" - an adage which appears numerous times when searched online, usually in web forums dedicated to programming (Google, 2015). Similar observations have been made of British academia, with an image consultant telling the Times Higher Education magazine that many female academics feel pressured to "dress down", and "governed by an unspoken dress code in which scruffiness is a sign of intellectual rigour" (Reisz, 2013). The 'scruffiness' of the imaginary archetypal programmer can be understood as a reflection of the cultural values held within the field.

When some techies' rejection of sartorial fashion is considered alongside their attitudes to 'flashy' or heavily branded technologies, there is a more general rejection of aesthetic style – what might be termed a techie anti-aesthetic. As notable from this subsection, this seemed to be a set of ideas most openly expressed among some of the older participants who had grown up with 1980s microcomputers or early PCs. Rejecting 'flashiness' - whether an item of clothing or piece of sleekly-designed consumer technology - is a refutation of the idea that things should serve an interpersonal role. This suggests a utilitarian attitude which asks to be evaluated based on action and ability as opposed to visual presentation. The accounts offered so far suggest that this type of attitude is present from childhood, rather than being something acquired later in life. This turning away from the visual, and from the body – from people and toward things – is, as Sherry Turkle (1986) argues, a behaviour more frequently associated with masculinity, which then works to code computing as masculine and to subsequently deter women. Ironically, then, while the suit and the dress more explicitly emphasise biological sex differences, they also connote that the individual is person-oriented; that they exist to interact with others. Scruffiness may be without gender, but it represents a prioritizing of function over form more often associated with traditional masculinity than traditional femininity. Stereotypes of 'scruffy' programmers persist because they have some basis in reality, and this is partly rooted in the blurred line between enthusiastic hobbyist and professional coder.

4.2.4 Gaming at Work: a New "Golf Course Culture"?

In amongst these observations about the institutionalised informality within the tech profession are accounts of offices where computer games are played on-site. For example, 24-year-old Max had spent the past two years in a company which provided technical support to companies working with Apple Mac computers. He offers an example of the role of videogames in "techie" office culture, which also hints at how this may function as a sort of social filter; enabling bonding only between members of staff who are willing or able to play:

> Max: Before I joined the company they would run their own little LAN parties um, things like ten or so people they would have. That all stopped because it became a bit expensive because they actually provided PCs and kept them maintained … but now, after work, CS [Counter-Strike] gets played a lot, used to play Unreal Tournament 2004, basically any of the games that will run on a Mac, coz everyone's got Mac laptops which aren't really the most powerful, but yeah there's definitely a culture of everyone likes to play games, more or less. Apart from, there are two or three people out of the twelve of us who will play but they're not really that interested, but they'd much rather go home and see their significant other and/or kids.

As noted in previous chapters, Max has been a PC gamer since his early teens and, unlike many PC gamers, has never owned a console, preferring instead the pastime of gradually improving a gaming computer. As such, he is perfectly at home in an office where staff meet to play some of the most popular PC titles. Staff members who would "much rather go home" might represent a minority in tech companies like the one described, but a majority in other scenarios. In fact, when explaining the appeal of LAN-parties, Doug explains that, the actual activity of gaming is secondary to socializing with "other geeks". Visiting (or in Doug's case,

organizing) a LAN party is "a good way of mixing with similarly minded people... if you are of a slightly geeky nature, going to a place where geeks are the norm rather than the exception is a great environment." In-office gaming is, therefore, not simply a leisure activity for its own sake, but one which secures the environment as belonging to a certain type of person - note that Doug, in contrast to Max, works in a secondary school; an environment where computer geeks like him are in the minority.

David offers a similar description of office gaming, albeit one in which he is not directly involved. As a hobbyist growing up during the 1970s and 1980s, videogames are absent from David's biography. He puts his non-gaming down to generational differences, although, as noted in 3.1.2, other respondents were heavily interested in games during this period. During their lunch-breaks, most of David's team of programmers play Counter-Strike, a widely popular FPS among PC gamers which is also old enough to run on current PCs not specifically built for contemporary 3D gaming. Several of David's staff have also expressed some interest in modding the games they play; an ambition David describes as "a lot of work" that he himself would not want to do in his spare time. Despite not identifying as a gamer, David refers to the group as "we" when telling me that "a couple of them have talked about [modding] the game we play". David's team represent the in-house software development department for a home electronics company, located at an entirely different site from the company's London base. All but one of his team are what he describes as "computer science guys". The remaining member works as a liaison between the department and the rest of the company, providing a "link between the business logic and the rules at head office in terms of what products they want, what features they want, when it rolls out, when they release it, all the type of boring stuff".

David and Max's workplaces orient around the provision of quite different technological services. David's company are involved in research and development and the production of software, while Max's workplace provides technical support to users of Apple computers (although they are not directly in the employ of Apple). The majority of the staff managed by David are software developers whereas Max's colleagues largely provide tech support (Max himself programs in his spare time as a hobbyist). But despite the different foci of these offices, both feature PC gaming as an everyday activity; an unquestioned part of the informal workplace culture shared by the majority of their staff. These "computer science guys" are inferred as male in David's description, whereas the non-players in Max's office are usually marked by the presence of a "significant other and/or kids" at home. As such, neither account does much to challenge the stereotype of the male tech nerd who eschews interpersonal relationships in favour of technology.

Gaming at work, in this context, could become a new form of "golf-course business culture" i.e. one in which important businesses decisions are made during what are historically male-centred leisure activities (Miller, 2004; Arthur, et a1., 2011; Rutherford, 2011; Faraday-Brash, 2010). Leanne Faraday-Brash (2010) argues that:

> The reality is that business organizations are typically still male-led and are dominated by male culture and assumptions. Corporate language is often competitive, even ruthless: idioms are based on sport and war, deals are made on the golf course, corporate boxes at the tennis are legitimate business expenses, and men receive informal mentoring and support and they know it. (p.73)

In her research on changing gender dynamics in the workplace, Sarah Rutherford quotes one Human Resources manager who describes golf as contributing to a "strong sense of male affinity that you sense rather than necessarily see" (2011, p. 161). Arthur et al. (2011) found supporting evidence that golf functions as a barrier for women in professional networking. While it is impossible to speculate as to how widespread this practice of PC-gaming in lunch-breaks really is, it is worth considering how the incorporation of such a leisure activity might work as social cement for employee-gamers, while excluding those who do not play. The "old boys' network" culture that still deters some female STEM graduates from their chosen career paths (Fouad & Singh, 2011) may be potentially exacerbated by this, for those who do not have such an explicit biographical link between gaming and their interest in computing. These findings, though not representative of the entire sample group, illustrate another way in which gaming cultures might mediate entry into technology-related workplace – or at the very least, give some an advantage in terms of social networking.

4.2.5 Blurring of Work and Leisure Concepts in Techie Biographies

Taken together, the findings presented thus far in this chapter go some way to characterising techies as a professional group who experience a large degree of overlap between leisure and work – as previously suggested in subsection 1.2.2 of the theoretical framework. Older respondents like Neil and Doug were more like to speak of 'geeks' or 'techies' in general terms like 'rebellious' or 'goofy'. These older respondents are also in a unique position to speak as they have worked with considerably more people in the field and have both managed larger teams of programmers. Attitudes to school and work, pranks and gaming, style and functionality, are rarely consciously connected in respondent's narratives, but offer clear binaries of formality and informality when viewed from the outside.

Techies often exhibit subtle resistance to school and workplace authority, manifested through spoken disdain, but also through minor acts of subterfuge. Technological pranks operate as a form of self-identification for technologically-skilled individuals in schools and workplaces, marking them out as a distinct group and elevating their skills above those of others, such as non-technical colleagues and clients. Techies often define themselves against others – from institutional authority figures, to non-technical colleagues and outside clients - just as they define themselves against the institutions more generally. When complaints about the ineptness of both clients and teachers are considered together, these parallel themes of school and work bind the past and present in the biography, illustrating how the computer geek or techie identity is constructed in terms of difference. Being a techie or a computer geek is not simply about possessing technical knowledge, but about a particular attitude to that technical knowledge.

The informal culture surrounding this group is also shown to extend to rituals of gameplay which represent a transgression in a school setting and a sanctioned yet informal part of office culture in some tech companies. Although not always occurring in the same biographies, accounts of school and workplace gaming suggest continuity between informal peer cultures in both settings: Gaming during school lessons or lunch-breaks becomes a social glue, one which cements the subcultural status of small friendship groups of young 'techies' while also giving them an opportunity to gain status among the broader peer-ground who like gaming but do not identify with computing culture. In the case of offices where most employees

game, lunch-time and out-of-hours play can have the effect of excluding some co-workers from social ritual which is potentially time-consuming and inaccessible to those who are unfamiliar with the controls or conventions of the preferred game types. Gaming, as a shared ritual practice – an informal leisure activity often occurring in or alongside more formal settings such as work and school - may have a shaping effect on staff hiring and retention, playing an under-acknowledged role in peoples' identifications as 'techies'.

4.3 Conclusion

By focussing on respondents' beliefs and values in relation to education and work, this chapter has explored interplay between respondents' 'computer geek' or 'techie' identities and the educational and professional fields which they find themselves a part of throughout their biographies. On one hand, there is an occasional tension between the informality of 'techie' culture and the expectations of educational/work institutions in terms of behaviour, presentation and clear, efficient, target-driven work. This derives perhaps from the fact that the skills associated with the field are often obtained through playful, self-directed tinkering. Conversely, the professional field benefits greatly from these dispositions because ultimately the predominance of self-tutoring hobbyists somewhat diminishes the need for employers to allocate resources towards in-house training when, for example, a programming language or type of hardware becomes obsolete. The informal acquisition of skills – through a personal enthusiasm toward machines – feeds neatly into a profession where many are mandatorily expected to update their knowledge outside of work hours. The predominance of men within the field in question is, perhaps paradoxically, connected to the positioning of computers as an object of fun and pleasure in boys' earliest years (Haddon, 1990; Lumbar, 1998; Wajcman, 1991; Fisher, 2012; Barron, 2004). The computer geek career trajectory is, therefore, one in which any separation between work and leisure is considerably blurred; a hobby becoming a job over the course of a lifetime.

The term 'career' is often used exclusively in relation to trajectories of employed labour. However, following Goffman's application, 'career' as a sociological concept can describe any long-term identification. Career provides an appropriate metaphor for any long-term affiliation because it describes something which develops over time; it has the sense of being a progression or journey, as in the case of the types of hobbyist activities described by Stebbins as 'careers' of 'serious leisure'[37]. Thus far, computer hobbyism has been characterised in just such terms; as a 'serious leisure' career which often culminates in professional careers in the technical middle-class. In the case of IT workers who have grown up as hobbyists, the subjective hobbyist career feeds directly into a professional career trajectory and they exhibit a blurring between the concepts of leisure and work (discussed previously in 1.2.2). As such, the 'techy' identity comes to represent either leisure or work identities but most often a fluid combination of the two.

[37] Stebbins' theories (and their limitations) are described more fully in 1.2.2.

Chapter 5: Orientations to Games/Computing Among a Teenage ICT Cohort

Chapter 5 identifies different levels of computing interest shown by a cohort of predominantly male teenagers, and how such differences relate to their gaming preferences and practices. The total group size was 20, with 6 students interviewed from one school, and 14 from another. In addition, one member of teaching staff from each school was consulted during the data analysis phase in order to corroborate the findings detailed here. Three main orientations to ICT are identified and discussed;

1. The "means to an end" orientation to ICT
2. Console gaming enthusiasts with some interest in making games
3. PC gamer/tinkerers who aspire to specific ICT jobs

Not all young people fell easily into one of the three headings, and some moved between categories as they spoke, but these give a sense of young people's differing perceptions of the subject and its utility, sometimes in relation to their own leisure uses of computer (e.g. gaming and related activities). That such variation existed even within two small classes at similar schools, indicates that relationships between gaming and computing are not simple. The PC gamer/tinkerers most clearly resembled younger versions of the IT workers whose accounts were discussed in previous chapters, while the console gaming enthusiasts illustrated a different type of orientation to ICT; where games were cited as a reason for enrolling on ICT courses, but where hobbyist programming and game development were absent from their interactions with computers outside of school. Although data regarding the students' achievement in class was not made available at the time, the three categories explored here were confirmed by one of their teachers (Debbie, 36; see Fig. 4b) in a follow-up conversation. Each of the three orientations discussed here also bears a strong relation to the kinds of domestic access and familial support for computing activities enjoyed by the young people in question.

5.1 Three Orientations toward Technology in the Teenage Group

In the two schools where the fieldwork was carried out[38], students chose a small number of courses to study during Key Stage 5 (age 16+). Only one female student was present in one class, and no female students were present in the other (the teacher of this class told me that they had never had more than two female students in any 6th form ICT class in the previous four or five years). As such, these classes present extreme cases of the male-domination of computing based subjects reported throughout the earlier parts of the thesis.

[38] Both schools were in areas of high socio-economic deprivation; see Chapter 2.

All of the students interviewed here had chosen to continue the study of ICT at a post-compulsory level. I spent a morning at each school, observing some interactions in lessons but predominantly conducting interviews about computing over the respondents' life courses. The young people were interviewed in a mixture of one-off interviews and friendship-pair interviews, according to their preferences (see Fig. 4a). The data analysed here illustrates the different types of investment in the subject carried by different students, and how this may relate to their leisure uses of computers and related technologies.

At both of the schools where interviews were conducted, students chose either four GCE A-Levels or a smaller number of vocational, course-work based BTECs. In both schools, students opting for ICT would take a BTEC in the subject, rather than an A-Level[39]. As such, the students heard throughout the coming chapter had chosen to specialize in computing, and some could be described as being in the early stages of IT careers. This was not, however, the case for around half of the students, who saw ICT as an employability or life skill, or were tangentially interested in the subject but expressed no clear plans to go into computing careers.

The majority of interviewees fell into either of the first two groups, with regards their career aspirations and reasons for choosing to study IT. Firstly, there were those whose career interests involved computers (rather than computing) and who saw their ICT course as a means to an end. These were young people with hopes of going into a variety of careers in which computers have become standard tools, but which have not always necessitated the use of computers (e.g. policing, business, art, photography, graphic design). The second large group were generally unsure about plans for the future, but tentatively said that they were interested in the digital games industry. Members of this group tended to play solely on consoles and are described throughout the chapter as the "console gaming enthusiasts"; a term which describes their play practices as well as an oft-mentioned desire to make games. The smallest group were PC gamers who could be described as "PC gamer/tinkerers" – those who had built their own gaming computers from a relatively young age and who found interacting with machines and programs intrinsically rewarding. This smallest group tended to mention very specific technical (e.g. "network manager", "IT technician" or "computer programmer") when asked about career aspirations. They also reported higher degrees of computer access from an earlier age, relative to the rest of their classmates. It is this smallest group whose formative experiences with personal computers and games most closely mirror the accounts of hobbyist self-tutorage offered by the IT professionals discussed in the last two chapters. As previously discussed, self-tutorage is not simply a benefit for entry into the professional field of IT but is often regarded as a standard, ongoing practice for maintaining a competitive edge within the industry.

These findings match somewhat with Lori Carter's research in American high schools (2006) which found that three main factors influenced enrolment on Computer Science courses; previous experience with computing; an interest in computer games; and perceived links between computing and some other subject of interest. Each of the categories used here appears to relate to the social demographics of the young people in the group, as well as their personal histories of interactions with specific technologies as seen in the previous chapters and reiterated here by the platform-specific "PC gamer/tinkerer" category.

[39] See Chapter 1-2 for a discussion of the different course types in UK schools.

The following sections delineate and analyse each of these groups in more detail, arguing that each represents a distinct orientation to the field of computing, although some variations will also be discussed. Naturally, other types of relationship may exist, but these categories were used to best depict some of the differences observed while collecting and analysing interview data. They were inductive categories, i.e. ones which arose during the process of data analysis rather than being sought out from the offset. The category of the PC gamer/tinkerer was an exception, partially drawn from a desire to find similarities between some of the young people and the older IT professionals I was interviewing. It is worth noting that the PC gamer/tinkerers were in a minority in the settings I visited, although this ratio may have varied if access were gained to schools with different intake demographics.

5.1.1 The "Means to an End" Orientation to ICT

From the perspective of the budding designers, computers were described primarily as a tool. Dom (16) was interested in graphics, or making "art on a computer". Patrick wanted to become a car designer and was therefore interested in learning computer-aided design programs to complement his Art and Design course. Kelly used Adobe software to edit photographs and create vector graphics at home. In these cases, computers could be a useful tool for the creation and distribution of expressive art. They also enabled the use of software which could be used for careers in the design of digital or physical products – career goals all deeply rooted in personal hobbies. But in these cases, computers were not necessarily interesting in themselves. In the case of the students aspiring to business and policing, IT was seen more as a functional skill expected in modern workplaces, and not something to be enjoyed as an intrinsically pleasurable hobby.

Those in the "means to an end" category were least likely to fit the white, male, middle-class[40] demographics associated with the "computer geek" stereotype. Although the following observations are drawn from a very small sample, they highlight the need to examine nuanced differences in the ways different teenage boys engage with videogames, rather than treating boys as a homogenous demographic for comparison with female non-players[41]. For example, nineteen year-old Eli was the only black British student interviewed in a school whose intake consisted mostly of white working-class and eastern-European migrants. Eli's family bought their first computer when he was fifteen, which was relatively late compared to most of his classmates. Eli said that, although he does enjoy using computers, his main reason for taking the course was to "use the computer for spreadsheets, letters, making memos for meetings" in order to "do a degree and become a businessman". Bradley and Jordan were also studying ICT as "more of an employability thing". Jordan had only acquired a laptop very recently and his parents had never owned a computer, whereas Bradley had access only to shared family computers while growing up. Both boys also had older brothers who "did everything" when it

[40]Although no data on the socioeconomic status of participants was collected, and both schools were in low-SES catchment areas, those in the "PC tinkerer" category tended to have more technology at home, and were also more likely to mention having parents who were interested or employed in computing.

[41]As discussed in the review of literature, qualitative research with American teenagers has identified how white and middle-class boys are more likely to foreground gamer and/or computer geek in their public identities and relationships with peers (Sims, 2014; DeVane & Squire, 2008; DiSalvo & Bruckman, 2010; Seiter, 2008).

came to home computer maintenance at home, negating the need for Jordan or Bradley to learn much about how to install or maintain computer hardware and/or software. Jordan's brother had attended the same school when IT education had been more focussed on programming, and was regarded as someone who "knows what he's doing" with computers. Bradley planned to study at university in order to join the police force, and Jordan similarly described an IT qualification as something "useful for the future" rather than as something inherently pleasurable to undertake. This pair stood out in their class as adhering to more typically working-class "laddish" codes of dress and style, and had more interest in sports than in geekier pursuits like gaming. When asked about games toward the end of the interview, they mentioned only football-related titles. As such, they were not part of the more gaming-centric group which made up the majority of the classroom. Similarly, Eli was wary of games and spoke about them as a potentially addictive distraction from his primarily goal of obtaining well-paid, high-status work through education.

This first group reflected an expectation that Key Stage 5 ICT would be an extension of the existing curriculum for 11-16 year olds; which had tended to position them as end-users of software, rather than software creators[42]. As such, the difference between this group and the smaller group of 'tinkerers' illustrates the different (and perhaps even incompatible) expectations that students bring with them when entering post-compulsory ICT. Those who have taken ICT courses as a 'means to an end' demonstrate the perception of computing skills as valuable within other fields, and their existence alongside the tinkerers illustrates the difficulty schools face in catering to young people with different types of investment in the subject.

5.1.2 The Console-Gaming Enthusiasts

The second large group consisted of boys who played games primarily on consoles and also used console gameplay as a main form of evening socialization with each-other, through the use of chat headsets and the Xbox Live network. A few of them also played PC games occasionally, but – unlike the "tinkerers" - had not built the PCs which they used for gaming. Most of the console enthusiasts were generally unsure about what they wanted to do with their qualification, although several of them tentatively expressed some interest in a career in game development. Although around one third of the second class visited expressed some interest in making games (Grant, Jack, Dmitri, Craig and Karl) they also tended to express frustration at a lack of knowledge or resources required to pursue this interest at home. This is illustrated in the following discussion, taken from a group interview with Dmitri and Karl:

JBW: What are your main reasons for deciding to study IT?

Dmitri: Probably game design or development.

Karl: Yeah, roundabout the same.

[42] Prior to recent changes which have introduced programming as a key skill for children as early as Key Stage 1 (age 5 in the UK).

JBW: I was speaking to Miss earlier and she was saying there was quite a big group in your class who would like to go into that.

Karl: I guess it comes from, kind of, playing games, mainly the Xbox ones.

JBW: Have you spent much time looking at how it's done?

Dmitri: Uh yeah… we did some programming.

JBW: Miss said you had done a little bit of Scratch which is kind of an entry into programming.

Dmitri: We've done a bit of Java as well.

Karl: Yeah 'cause in our other unit – in our other class - one of the units was game design of a mobile app. We had to do like all the locations so that it picked your location automatically in the school.

JBW: So, sort of a game that used your real location? Cool.

Karl: It wasn't that good though <laughs>

JBW: Have either of you tried doing any game design at home?

Dmitri: I've tried UDK [Unreal Development Kit]. I have it. But it didn't turn out too well 'cause my laptop's not that powerful.

JBW: I guess if you started with something 2D it might be a bit less demanding on the computer?

Dmitri: Yeah, probably <laughs>. I've tried GameMaker as well, but that was a little confusing, how you had to assign the actions. I didn't like that one.

Karl's in-school experience of making a game has produced something that "wasn't that good"[43], and he has had no experience of making games at home because his own personal computer "blew up", leaving him with nothing to freely install software onto. Dmitri, on the other hand, has tried game-making software at home, but found programming difficult and was unable to run 3D software on his laptop. Both of these cases illustrate the costs involved for young people beginning to produce games freely in their own time, even when the software itself is available for free. In addition, Dmitri's account suggests that the individual tastes of young gamers may affect what they aspire to make (e.g. a preference for up-to-date 3-dimensional graphics over more simple, "retro" 2-dimensional ones) thus acting as an initial barrier to participation in game-making. The process of moving from player to creator requires an inversion of the player's usual order of perception, as argued by designers Hunicke et al.:

> From the designer's perspective, the [game] mechanics give rise to dynamic system behavior, which in turn leads to particular aesthetic experiences. From the player's

[43] In a review of the literature on educational game-making, Hayes and Games (2008) have argued that "... if they games [students] ultimately create are not very good, the students may not have much motivation to continue making games or using their newly acquired programming skills." (p. 18)

perspective, aesthetics set the tone, which is born out in observable dynamics and eventually, operable mechanics. (2004, p.2)

The question of whether aspiring young designers have begun to perceive mechanics as equally or more important than aesthetics is an important one. When asked about what they played, only a minority of this peer group mentioned any less graphically demanding games[44], tending to focus on big-budget mainstream titles with polished graphics. There is, therefore, a notable difference in the cultural setting for today's budding hobbyist game-maker, and the micro-programmers of the 1980s[45]. The latter were able to produce games which bore a closer resemblance to the commercial ones they played - particularly in the case of the then-popular text-adventure genre - albeit without the help of internet communities for support. For gamers like Dmitri - who show an interest in making games but who only play high-fidelity commercial titles - the standard has been set by an industry in which production teams can exceed one-hundred staff, and where budgets for individual games often exceed $30 million (Crossley, 2010). Grand Theft Auto V (2013) had a combined development and marketing budget of around $170 million (The Scotsman, 2013) and was released the same year as these interviews were conducted. In order to become involved in entry-level game design and programming, players like Dmitri have to re-orient themselves away from the now-widespread emphasis on graphical fidelity which is a driving logic of the industry.

Lewis, in contrast, said he chose IT because he enjoyed programming and wanted to become a professional computer programmer. Lewis did not explicitly mention game development as a career preference, yet he also said that he has done some command-line programming at home, making "little games" as projects to learn programming concepts. As a result, he presented himself as having had the most home experience of game programming, despite the fact that he did not mention game development as a desired career as several of his peers had. While Dmitri's attempts to make games were motivated - and seemingly frustrated - by the desire to produce a working, attractive game, Lewis' creative activities were somewhat different in nature, emphasizing the making itself as pleasurable:

Lewis: I chose IT because I wanna go into computer programming, 'cause I like programming things. I normally do quite a lot at home as well. I just, like, design little games using standard programming software and things. For about 2 years? Since I was like 14 … You read webpages and look stuff up; see what people have programmed, get other games, get the programming for the actual game. I start by looking at indie games, and I'm still pretty much at the indie game stage.

Note that "programming" is the dominant theme in this excerpt, with games being a project through which to refine skills. As with some of the older hobbyists discussed in previous chapters, Lewis appears to find programming inherently interesting, and therefore the process of making a game is actually one in which learning programming is part of the enjoyment, as

[44]e.g. Older arcade games, or indie games produced by smaller studios; often working with small teams and freely available software.

[45]Discussed throughout Chapter 4.

opposed to an irritating hurdle. The same cannot be said for Karl or Dmitri, who are oriented around games as a primary object of interest, but find frustration – as opposed to pleasure - in the actual process of trying to make them. Note also that Lewis expresses a desire to become a "programmer" as opposed to anything specifically related to game development – which places him more in the "tinkerer" orientation (his account is discussed here mainly to contrast it with the other students who expressed an interest in game development).

The hobbyist curiosity demonstrated by some students' forays into game-making software (Dmitri) and programming environments (Lewis) appeared to be largely absent in the case of one interviewee in particular - Craig. Although game development was his stated career goal, his expectation was that a job in the industry could be achieved purely through work undertaken within courses of formal education;

JBW: Have you looked into game-making programs or anything at home?

Craig: Mmm, no. I haven't really looked into it to be fair. I've just like, obviously started looking for universities. And I dont think I'm gonna get into university. I need two As and they're all Cs at the moment, so I havent really looked into it much.

Craig's interests were also relatively broad (World of Warcraft, playing football, studying performing arts) which might make him less inclined to intensively focus on computing as either a hobby or vocation. However, the above exchange also reveals something about Craig's perception about education in general – that the formal outweighs the informal in terms of significance. Even if he were to achieve the grades mentioned, how would he fare in an environment alongside hobbyists who have the advantage of having programmed since their early teens, and who are in the habit of updating their skills constantly, through self-tutorage at home? Craig's perception of formal ICT education being enough to secure a job relating to his hobby contrasted strongly with the accounts offered by the four game developers heard in previous chapters; all of whom had been making games at home long before they even considered it a potential career choice.

Taken as a whole, conversations with this group of young male console enthusiasts reveal a number of things. A love of games contributes to their interest in studying ICT, just as a love of books or film might drive an interest in English or Media. This career pathway is attractive because it seems to revolve around an object of pleasure (games themselves) but the boys I spoke with all had very little experience of actually making games, and what experience they did have had often been frustrating for them. Only a minority of those who expressed a desire for game-making careers had really acquired the sort of self-determining hobbyist mind-set associated with computing. A recurring characteristic is that these young men do not (yet) enjoy the actual process of making games, namely because making even the simplest type of arcade game requires more knowledge of programming than they have encountered throughout their time in school thus-far. It may also be the case that expressing an interest in game development was, in some cases, a socially performative statement (especially seeing as these interviews were conducted in friendship pairs).

It would be easy to dismiss expressions of interest in game development as an unattainable dream for teenage gamers who are largely uninformed about the realities of work in the games industry[46]. However, educators generally do not discourage the student who chooses English Literature in hopes of becoming an author, regardless of whether or not this aspiration appears attainable. The same is true of any other subjects linked to "cool" creative professions. One would, however, expect a publicly-expressed interest in a creative field to extend to the home and perhaps (as is the case with many of the self-taught hobbyists heard earlier in this thesis) to be something which exists primarily at home, with school fulfilling a supplementary role. Lewis' game programming and Kelly's photography are examples of this; where school is treated as a formalization of a serious leisure activity practiced domestically. What is concerning about this group of young men, then, is not that they have unrealistic aspirations (game industry jobs do exist[47]) but that they lack the opportunities and support to be able to follow through with them outside of school in the way that the adult game developers I spoke to had during their formative years. Some of the younger interviewees have enjoyed less access to the physical resources and family support which would enable them to become self-teaching hobbyists.

5.1.3 PC Gamer-Tinkerers

The PC gamer/tinkerers resemble, in some ways, younger versions of older IT professionals like Max and Greg from the7 previous two chapters. This younger generation share similar experiences of having relatively early access to a PC, and of being able and/or allowed to build and rebuild their own machines. Note that - like Craig from the previous section - playing games on a PC did not automatically place a respondent in this category. Rather, as discussed throughout previous chapters, it is PC-gaming which brings a young person into a constellation of possibilities for other, tangentially game-related used of computers including programming games, modifying existing gaming content and building or upgrading machines to play more graphically-intensive games.

Paul and Andrei are both examples of the "PC gamer-tinkerer" orientation among the younger group of student interviewees. Paul aspires to be an IT technician, and spends his spare time "helping people with fixing their computer… like changing boards et cetera". He built his first computer when he was around the age of eleven and regularly upgrades it with new parts. The games he plays aren't necessarily PC-specific; he enjoys racing games like Need for Speed: Most Wanted (2012). Although the racing titles he enjoys are also available on consoles, he likes to install PC-exclusive mods[48] for these games, which extend his interest in them – although he has never made his own mods. Andrei's experience is similar to Paul's. The following excerpt represents a condensed version of our interview, but it illustrates the threads between Andrei's gaming experience, his hobbyist computing practices, and his orientation to ICT as a field of study in relation to a specific IT career:

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[46] For example Seiter (2008) and Aneesh (2001) have both been critical of the misleading characterisation of computer-based work as entirely glamorous and design-oriented.

[47] See, for example (Livingstone & Hope, 2011; CBI, 2014) for arguments that the UK games industry is commercially lucrative, but also suffering from a shortage of workers with the appropriate computer science skills.

[48] See subsection 3.2.1 for a more thorough discussion of game modding.

Andrei: My job interests are, I plan to become a network administrator, which is, administrator of a network. So I thought that picking IT would probably be a first choice. I also have a background in computers, worked with computers with my dad, built a couple of models, played with software, different types of software like Photoshop, uh, programming software like Microsoft Studio and I've used different versions of windows which dates back to windows 98 or 95.

JBW: Network administrator is very specific. How did you get interested in computer networking?

Andrei: Well gaming, and also just for experimental reasons. We've [Andrei and friend] set up php chat clients and networks and stuff.

JBW: So do you have a preference for what you play on? Like console or PC?

Andrei: Uh yeah PC is my preference.

JBW: What do you play?

Andrei: MMOs like DC Universe, wargames like Planetside 2. Sometimes I play Warcraft 3 with other people.

JBW: Warcraft 3 is quite old now... you seem quite knowledgeable about older games.

Andrei: We still play new games, but we have played old games, like I've played the Ultima series. Which dates back to almost 2 decades ago.

As PC tinkerers, Paul and Andrei constitute a classroom minority who have learnt about computers outside of school and arguably beyond what is usually offered by the ICT curriculum up to that point. When asked about their career aspirations, both reported aspiring to specific technical roles, compared to the more vague desire to make games expressed by many of the console gaming enthusiasts. These PC gamer/tinkerers are young people who have built their own computers during early adolescence. They have also come from households where this type of activity is supported, if not encouraged, while other interviewees said that they were limited in what they could try out on home PCs which were shared by other family members. Here we see evidence for the role of PC-gaming hobbyist in the process of cultural reproduction within households belonging to the technical middle-classes, discussed previously in 5.1.1.

Despite a preference for PC gaming, Paul and Andrei both owned and used consoles, because online console gaming and chatting over headsets were important social activities their peer-group took part in during the evenings. Again, the chance to own both a current-generation console and an up-to-date gaming PC highlights the economic barriers to certain parts of gamer culture. While Paul and Andrei have largely different tastes in terms of games, both of them derive additional pleasure from playing with and mastering the PC. Paul likes the fact he can find, download and install mods for his racing games which make them look more visually impressive than the console versions, while Andrei's history of building and rebuilding PCs coincides with access to a series of much older PC-exclusive games. Their platform preference potentially isolates them from the console-gaming bulk of their peer group, while also expanding the range of gaming-related activities available to them and giving them clout as technological experts among the group. This illustrates a key difference in the historical context

in which this generation's more serious uses of gaming machines occurs, compared to the older participants (4.1.2; 4.2.2) who were undertaking similar activities before the mainstreaming of online console play in the first decade of the 21st Century. The relative niche-ness the PC-gaming tinkerer is further illustrated by the following exchange, where Eli[49] describes the gaming habits of his peer group:

JBW: Do your friends play consoles? Or do they play on PCs?

Eli: I don't think a computer even goes in their mind. I see a lot of boys with just... I don't really think they would use or get computers just for games. They mainly use them for social networking and to do their work, but for gaming? Nah, I think they would just get a game console really.

The activity of gaming, in itself, is generally conceived of as a leisure activity, pastime or hobby. But access to, and familiarity with high-end gaming computers seems to orient young men like Paul and Andrei in a specific way. In these cases, gaming takes on the status of serious leisure, becoming entwined in their informal learning biographies and their individual goals for future careers and lifestyles. This was not necessarily the case for every student who reporting having played on a PC; rather it was characteristic of PC gamers who had been allowed, encouraged and financially enabled to build their own machines.

IT classrooms may, therefore, be in some ways socially differentiated based on preferred gaming platforms, for the above reasons. This leads to the perception of PC gamer-tinkerers as more knowledgeable than their peers. Take, for example, the following excerpt where Andrei (not present) is described as the "class expert" on computers, who peers will ask for advice on anything related to technology.

Luke: My first laptop was this Christmas so... I usually go on the computer, but when everyone wants to do the exact same thing.

JBW: Do either of you guys have older siblings?

Lewis: Yeah.

Luke: I'm the oldest.

JBW: So are you like, the expert in the house now?

Luke: I wouldn't call myself the expert. My brother games more than me. My parents know what they're doing with computers. Or they call somebody coz well I'm not… we're no experts on computers. You've already spoken to Andrei so I think you've got the best expert on computers in the entire room already.

JBW: Yeah; he was saying that he's grown up with a dad who was very into it and has a couple of computers where he could set up networks and stuff like that.

[49] Eli was one of the "means to an end" ICT students, in a different school from Paul and Andrei

Luke: Yeah, Andrei is obsessed with the computer. Well, not obsessed, but he's really good with them. In fact, when I was going for my PC, my laptop, I consulted him to see which one he recommended.

Luke frames Andrei as the class technological expert, partly down to Andrei's history of PC gaming and the activities he has engaged in through and alongside playing games on the PC. Note that Luke initially uses the word "obsessed" before noting its possible negative connotations and withdrawing it. It is clear from some of the discussions that the PC gamer/tinkerers are viewed as experts by other members of the class.

Console gaming is the socially accepted "norm", but several respondents emphasize that they would prefer to play on PC, perhaps due to a perception of PC gamers as more technically knowledgeable. In the following excerpt, Dmitri emphasizes that PC would be his preference, despite having access to several consoles:

JBW: What platforms do you play on; console, or pc or both?

Dmitri: Well, I try and play on the PC but my laptop ain't good enough. But then I would play on consoles as well.

Karl: [to Dmitri] With you though, you play on two different consoles, coz you've got a PS3 and an Xbox.

Dmitri's expressions of preference in this interview are indicative of his stance on gaming platforms. He owns both current console systems but foregrounds his interest in PCs. Dmitri foregrounding the PC speaks to a perception of social desirability, although it is unclear whether this reveals his perception of other members of his peer-group or of myself as a researcher. It is possible that there is a certain amount of tension around expressions of platform preferences. The more extreme examples of online "fanboyism" for PCs or specific consoles was earlier discussed in 3.3.1. However, the discussions in 3.3.2-3.3.3 illustrated how, outside of the context of hyperbolic online debates, real-world adult friendship groups discuss these matters in much more nuanced and cagey terms. Another interview with a different pair of young people shows one boy - Paul - initially presenting his gaming habits as "the same" as his peers, before changing his preference mid-conversation:

JBW: You mentioned you are both gamers. What sort of games do you play?

Ned: FIFA, [Call of Duty] Black Ops.

JBW: [to Paul] Are you the same as well?

Paul: Yeah, yeah.

JBW: Do you play on the console as well?

Paul: Well I play on computer; I play all my games on the computer.

JBW: Oh. You don't have a console at all?

Paul: An Xbox 360.

Ned: Everyone's got an Xbox [laughs]

It may be possible that the PC gamer/tinkerers face a social dilemma; the console is the more widely owned technology and is more frequently used for after-school socialization among the peer-group ("everyone's got an Xbox"). However, being a PC gamer bestows some status upon them as technological "experts", as shown in Luke's description of Andrei. This expertise comes at the expense of having to own multiple machines; a PC for gaming and tinkering and a console for social gaming.

5.2 Gaming and Teenagers' Developing Computer Literacies

5.2.1 Console Gamers, Bug-Spotting and the Authored Game

While the console gaming enthusiasts consciously connected their console gaming to their interest in the IT field, they could offer only a few examples of how it was tacitly related. An exception to the rule lies in the form of 'bug-spotting'. This practice entails finding errors with a game, and because it is an observational process which requires no intervention in the form of special software, it is something which can be practiced by PC and console gamers alike. In this example, Luke has been asked directly to elaborate on how his love of gaming relates to his study choices:

JBW: You said earlier that you might want to go into engineering. Do you think your interest in games relates to that at all?

Luke: Well, as I've played games I actually looked at what they do and I've realized how those things are actually made, they just program people to say stuff at the right times. In Skyrim I can see all the bugs, I can see what they're supposed to do so I can see that's how they're programmed to work.

While most of the examples of game-making given in earlier chapters are very specific to the PC platform, this excerpt hints at the ways that playing on the console platform may still provide opportunities for technical learning. A similar perspective on the capacity of console games to incidentally encourage a certain type of thinking was identified in one of the interviews with an older respondent – Lee, a programmer at a games company. His perspective is included here because he offers an example of someone now working in games, who had a similar experience of bug-spotting on console games.

Lee: …even then [age 7/ 8] you get interested in bugs or glitches in the game that let you sneak on a bit. There's one in MegaMan where if you jump before going through a door it takes you to a totally different world. stuff like that is always...

JBW: It makes you realize it's something somebody has made?

Lee: Yeah exactly. People complain that computers are rubbish - you know - "this bloody computer!" But it always comes down to - somebody programmed that computer what to do. Something like a byte flipped the wrong way and something weird happens.

Bug-spotting is a practice that gamers engage in regardless of platform, because it only requires the player to identify something that is broken in the software, as opposed to change anything about the software. Deliberate glitch-hunting, or 'glitching', is sometimes a preferred mode of play for those who have often already exhausted all other opportunities presented by a game (Meades, 2015). What connects Luke and Lee's accounts is the way in which this activity draws the young player's attention to the materiality of the game. Flaws in the game reveal its artifice, making obvious the fact that it was made by other humans. In other terms, accounts of bug-spotting indicate a shift in understanding, where the locus of control[50] is no longer centred on the machine itself, but on the practices of real people who program the machine function in the (un)intended way. It is also an acknowledgement of programs as authored texts, which can be viewed as an integral part of media literacy

As with the adult IT professionals who were the subject of previous chapters, young tinkerers like Andrei and Paul best illustrate a relationship between games and computing which goes beyond enthusiasm and towards genuine efficacy-building. Here, gameplay supports incidental learning activities like setting up local area networks - an activity Andrei had also encouraged a less confident friend to try with him. In contrast, most of the console gaming enthusiasts were illustrative of a link between gaming and a more nebulous and generalised type of enthusiasm toward ICT. They felt some sort of link between the technologies they used to play and the field of computing, but did not necessarily express much enjoyment of specific computing activities such as programming or computer maintenance.

Just like Kelly the graphic designer and Patrick the automotive design enthusiast, the teenage boys who identified games as a desired career pathway seemed primarily interested in computers as tools for doing something related to their hobby. They seemed aware that ICT would be useful or necessary for a career involving games, but they seemed unaware the extent to which games-industry workers are expected to be hobbyists consumed by the activity of making things. This enthusiasm should be differentiated from a more utilitarian idea of computer literacy – where specific, concrete skills may be acquired through incidental learning occurring in and around gameplay. Rather, the console gamers expressed a type of generalised technological efficacy through their enthusiasm – a confidence which was not necessarily indicative of the higher computing literacies obtained informally by the minority of tinkerers. Console game play is, in software terms, an 'end use' activity insomuch as it provides no opportunities to write or edit game content. As such, it can potentially provide some opportunities to begin thinking about games as authored software – including how or why errors may occur - but it does not provide the opportunity to observe the game's scripting in the same way as the modding tools available to players of some PC games.

[50]"Locus of Control" is a psychological concept describing whether an individual believes themselves to be in control of evemts (internal locus) or whether control is elsewhere/external (Kerawalla & Crook, 2002). The concept has a long established history of accounting for people's positive and negative attitudes to computers (Coovert & Goldstein, 1980; Broos & Roe, 2006; Woodrow, 1990)

5.2.2 Barriers to Learning through Tinkering

The marked differences between the PC gamer-tinkerers and the console gaming enthusiasts in terms of experience and resources raises a number of issues. Despite a problematic perception among older relatives and teachers of all young people as naturally-skilled 'digital natives', Apostolos Koutropoulos (2011) suggests that many young people are often afraid to learn computing by trial and error, for fear of damaging the computer or losing work (Kvavik, 2005; Margaryan et al., 2011). One major factor which distinguishes the PC tinkerers of all ages is that they recount having the resources and support to 'mess around' on computers at home during childhood or early adolescence. So follows the argument that the most powerful and 'sticky' form of learning is that which is self-directed, as learning technologist Koutropoulos suggests:

> If computer access and behaviours are controlled, either by supervision by an authority figure, or inconvenient placement of the computing device, the locus of control is external (Kerawalla & Crook, 2002) and this has an effect of inhibiting creative experimentation, and thus limiting the learner.

This concurs with Ellen Seiters' (2008) observation that the time and inclination to 'mess about' on computers more strongly guarantees their mastery, but that such opportunities tended to be afforded primarily to young people from families where parents are more likely to work in jobs where computers are not routine, administrative tools. Seiter also suggests that children from such households – usually middle-class ones – are more likely to be socialised around individualistic, solitary pursuits such as musical practice and reading, putting them in a stronger position regarding this informal learning. As suggested in Chapters 3 and 4, the older research participants often tended to come from households with at least one – usually male – parent or older relative working with or in close proximity to technology and tended to be 'ahead of the curve' in terms of acknowledging the significance of computer literacy in the acquisition of new economy jobs and encouraging it in their children/sons. The accounts discussed in the present chapter suggest that such informal learning experiences are few and far between for the majority of the young people interviewed.

The way that young people spoke about their pre-16 courses was indicative of the extent and limits of their experiences with computers at home. For example, in one class, two respondents enthused on the more 'hands on' aspects of their new course, indicating that they had little experience of such activities at home:

> Patrick: There's a huge difference ... it was just doing spreadsheets all the time… and now doing, like, the BTEC thing, it's more hands on, practical You take computers apart and look at them more and stuff like that, which is much better.
>
> Dom: In this one we get to take apart computers, inside, we see the real inside of the computer whereas in year eleven it was more 'this is how you make a Powerpoint'. Very basic, basic stuff but this is really whats inside, how it works, just, stuff I like really.

Speaking to the boys' teacher on a separate occasion revealed that this enthusiasm actually related to a single unit of their current course; a mandatory module dealing with maintaining a computer's physical systems. The course was, therefore, not entirely "hands on" in the way that Dom and Patrick described. Rather, they were foregrounding the hardware-related module in their appraisals of their current course because it was new and novel to them. Like most of their peers, Dom and Patrick had no previous experience of building computers at home. Although many of the young people I spoke to did in fact have sole ownership of a computer, these were often laptops; sealed units which require no assembly and little physical maintenance.

In contrast, Andrei and Paul - both 17 year olds from the other school - had been tinkering with and upgrading their own computers since early adolescence. In Paul's case, this simply meant gradual piecemeal improvements to keep up-to-date with current game graphics. For Andrei, the time he had spent with his father building PCs - and the relatively free reign he had enjoyed on computers since the age of 11 - meant that he had now moved onto other activities such as setting up networks between computers, a practice requiring access to more than one computer.

These examples highlight how conditions of access and ownership affect young people's engagement with - and expectations of - computing at school. The 'tinkerers' bring very different expectations to formal ICT classes than some of their less experienced peers. Because access and ownership affect the knowledge that young people arrive with, they also mediate their perceptions of what a computing pedagogy should prioritise i.e. what they do not already know. For Patrick and Dom, hardware maintenance was a completely new aspect of computing. This was not the case for Andrei, Paul and older respondents like Max, who - having already dealt with hardware at home - enjoyed a sort of 'head start' over peers. What young people expect to glean from formal computing/ ICT education, as well as what they express as being 'too basic' or 'better' depends on what they already know, knowledge which is strongly mediated by access and ownership of technology at home.

As the older IT professionals illustrated in Chapter 4[51], this form of self-directed learning is strongly related to the perception of programming as an inherently pleasurable 'mental challenge'. Finding pleasure in puzzle-solving was regarded as a necessary part of the mind-set required for work in the field of IT – where constant self-tutorage is regarded as a professional norm. Self-tutorage practices are regarded as necessary not only for initial entry to the field – but also in order to remain professionally competitive and up-to-date once employed. The self-tutoring orientation gained from early informal learning is not just a short-cut to computer literacy; self-tutorage is regarded by some as a professional norm within IT. At the same time, this kind of informal learning does not guarantee engagement with formal training, and having a higher level of computer ability than the majority of one's peer-group might lead to student disengagement in related classes (Carter, 2006). Negative experiences and perceptions of formal ICT education were a common theme in the accounts of interviewees who had taught themselves at home (4.2.1). Having parents heavily interested in history, art or literature might translate to a simple 'head-start' at these subjects in school, the relationship between technical parents and the incumbent ICT curriculum is less simple, namely because ICT in British schools has focussed primarily on administrative uses of computers in ways

[51] The perception of programming as "pleasurable challenge" was discussed throughout section 4.1.

which side-line the 'higher' literacies associated with computer work in the technical middle-classes, such as computer programming or an understanding of computer hardware.

As established in 1.2.3, consoles simply cannot provide as many avenues for incidental learning, such as building and maintaining machines or producing game content and related programs. This is not to say that young people's more casual uses of games are without value, simply that their value is different. Casual, sociable gameplay falls into a category of young people's leisure activities which are perceived as frivolous and 'wastes of time' by many adults, but which are defend by Abbot-Chapman and Roberts (2009) as "un-programmed 'time out' to relax and maintain social relationships or to withdraw and make sense and meaning of the barrage of sensations and information which daily bombard their lives, and to develop their own sense of independence and identity" (p. 243). The techno-enculturation thesis discussed and interrogated throughout this thesis is concerned primarily with connections between gendered patterns of gaming and technical careers. In the classrooms in question, the PC gamer-tinkerers were an exception. The majority of their classmates gamed as a sociable 'time-out' rather than to learn anything or because of any interest in technology.

This tension between individual desires toward hobbyist computing and social pressures around console gaming means a relatively high economic barrier to being both a skilful PC tinker and a sociable online console gamer: the PC gamer/tinkerer must own multiple platforms (and, in the case of the popular Xbox 360 console and a paid online subscription) in order to follow their own desires while also remaining part of the in-group. While the most expensive version of the new Xbox One will retail at just under £400 toward the end of 2015, a recommended gaming-PC setup described as "midrange" (PC Gamer, 2015) comes to a total price of around £810. The same website's recommendation for a "budget" gaming PC comes in at £546; still over one-hundred pounds more than the most expensive version of a new console.

The data here suggest that console-gaming does promote some level of interest in IT work – particularly in terms of producing games – although paradoxically it was the young people with the most experience of programming who expressed the least desire to become game developers. Console games may also inculcate a sense of being the 'computer person'. The findings in some way echo those of DiSalvo and Bruckman (2010) who suggest that:

> The participants' Internet access through digital game platforms, rather than computers, may be tied to economic or class issues, but also may be a cultural artifact of the play preferences for console game systems which better accommodate in-room and inter-generational socialization play practices. In either case, the impact of playing online through console systems rather than personal computers results in greater barriers to agency with the computational aspects of games. (p. 62)

Groups of young people for whom online console play is a primary form of social interaction face a dilemma in relation to engaging with less popular but potentially educational technologies. Only those with enough money to afford more than one system may engage in sociable console gaming with their friends while also being what I have described here as a 'PC gamer-tinkerer'. The investments of time required in research and practice – if they are to maintain their own PCs rather than buy them pre-assembled - all detract from the time they can spend playing with their friends. Such is the tension between 'casual' and 'serious' forms of leisure as theorized by Stebbins (discussed in 2.2.2). PC gaming carries connotations of aloneness, diametrically opposed to the social connectedness associated with the console. Helen

Thornham's (2008) ethnographic work with young British adults similarly noted that console-centric play with other players in the same room were viewed as more sociable, which solo play on a PC in one's bedroom is stigmatized as "geeky". However, with the near-ubiquity of online console chat-and-play platforms like Xbox Live - and what seems like a relative few young gamers using PC-equivalent services such as Steam – the perception and experience of consoles as the more sociable platform is strong among this younger cohort.

As noted in the methodology (2.2.1) the only two schools in the county which were willing to participate were comprehensive schools located in areas of high socio-economic deprivation, and also in a county with a selective education system. The console/PC gaming ratio may have been different with young people from different socio-economic backgrounds, as indicated by some of the existing research into youth gaming cultures explored in 1.2.3 (Andrews, 2008; Kline, et al., 2003; Itō, 2009; Seiter, 2005; Livingstone, 2002). As such, the gaming culture identified in both of the classrooms should be viewed as not only male, young and British but also as uniquely specific to a provincial, suburban and predominantly white working-class social milieu.

When asked to comment on these observations, the teacher of one group (the smaller class containing Dom, Eli, Harry and Patrick) provided some helpful context, suggesting that the PC gamer-tinkerer type I had identified was a historically-specific phenomenon whose visibility may depend on the nature of the curriculum on offer at the time. In an email exchange following the data analysis presented in this chapter, the teacher - Peter - offered his view on the observed connection between hobbyist computing, PC gaming, and interest in the academic field of IT:

> Peter: I would say that may have been the case with our older cohorts circa 2011; although not specifically PC gamers, as games consoles seemed to prevail. Later cohorts did not have the same level of gaming interest. Even at my current school, with over 50 students studying IT in 6th form, there is no significant interest in PC gaming other than the usual escapism during a lesson. I think that this has in most part been due to the nature of the ICT curriculum. As we move into a new curriculum specialising in Computer Science, it will be interesting to see how the interests of students taking these courses may differ. In contrast; during my time at University (1999-2007) as student and then researcher, PC gaming was considerably more popular with students studying Computer Science, Computer Systems Engineering, and Electronics disciplines. This manifested in the earlier years as organised LAN parties on campus. With the advent of affordable broadband, students later migrated to hosting games across the Web.

Peter suspects that connections between PC-specific play cultures and the academic study of computers is contingent on the nature of the curriculum (e.g. ICT vs Computer Science). In addition, as established in the first data analysis chapter, the informal learning activities associated with PC gaming have depended on the gaming practices most common at specific historical moments – such as online play verses the physical immediacy of a LAN party. Although the tinkerers identified here may, through their gaming practices, receive some sort of advantage in the field of IT - a point which is perhaps under-acknowledged by some educators - it is likely that they are relatively few in number. As such, the idea that boys receive

some sort of participatory privilege through their gaming habits - the central theoretical issue outlined in 1.1.1 – is much too general without inclusion of socio-economic status as a mediating variable; a dimension of identity often closely intertwined with ethnicity, depending on local contexts. If we take into account the relatively higher economic cost of being a PC gamer-tinkerer – as well as the frequent importance of highly computer-literate peers or family members, in the lives of these young people – it may be useful to compare how frequently this group are represented in schools with more or less deprived intakes, given that socioeconomic status has already been shown to mediate both platform preferences (1.2.3) and the uptake of computing courses in the UK (1.1.5).

5.3 Conclusion

This chapter has identified a need to separate a much more general and aspirational relation of gaming to IT, from the sort of tangible advantages that might be conferred by an early leisure career; assembling gaming machines and networks of gaming machines or dabbling in code. The allure of working in the games industry figured strongly in the accounts of the console gaming enthusiasts, but the machines on which they play do not provide them with the types of learning experiences which may help them develop skills required to follow their stated goals. In addition, the strong role of night-time online console gaming in many of the group's social-lives means that the PC tinkerers face peer pressure to play across platforms. While the three orientations described here are not strict groupings – respondents may have been partially in one category and partially in another – they help to give a sense of the connections between the young people's attitudes and their conditions of material access to technologies and knowledgeable adults.

By focusing on differences within a small group of young people, this chapter has illustrated how gender stereotypes and physical access to technology are not the only determinants of becoming a 'techie'. As Roli Varma (2007) notes in her study of female computing undergraduates in the US, women from lower socioeconomic class backgrounds were less likely to connect computing to their "sense of self" and "less likely than their upper- or middle-class white counterparts" to choose the subject based on its intrinsic appeal. The minority women in Varma's study were much more likely than white female peers to choose the subject "because it provided more opportunities for secure employment, higher pay, and better social standing". Even within classes comprised entirely of boys who play digital games, researchers should continue to interrogate how socioeconomics interact with gender to configure young people's play practices and, in parallel, their orientations toward computing. Larger scale, quantitative research could be undertaken to - following in Bourdieu - explore how new types of cultural capital - skills and attitudes valued in the field of computing - are related to socioeconomic status and social capital such as peer-group and family influence.

Chapter 6: Concluding Comments, Caveats and Recommendations

6.1 Findings

I deliberately sought out British IT workers in order to better understand the biographical factors which may have shaped their paths into well-paid technical professions. In doing so, I have offered explanations for why such a path is closed to a majority of young men and an even larger majority of young women. Before any further discussion of the research findings it is necessary to return to the original research questions, which were as follows;

> Q1: What relationship (if any) exists between digital play and broader 'computer literacy'?
>
> Q2: What values do those in computing careers attribute to different types of digital play?
>
> Q3: How do differing patterns of early digital play relate to educational/work careers in technology-based areas?

Together, these questions represent the overall aim of the thesis - to better elucidate some of the connections between gaming and careers in tech. However, answers to the initial research questions are interlinked and cannot be disentangled. There seems to be some degree of truth to the idea of a persistent, intergenerational relationship between male-oriented gaming cultures and men's higher levels of participation in computer-related professional fields. As illustrated in the first part of Chapter 1, feminist games researchers have sometimes treated relationships between masculinity, gaming and technology as an a priori assumption supporting the rationale for important research into the gaming habits of some girls and young women. Rather, it is more accurate to say that while a stated interest in game development may bring some boys into ICT and computing at the post-compulsory level, it is a much smaller and more specific niche of PC gamers who have received the more significant type of 'head start' with regard to technical skills. This smaller elite group often come from homes with access to particular types of machines and adult support; allowing them to have greater informal experience of computing than that offered by the school curriculum. While gender is an obvious defining factor in determining who goes into computing, researchers should continue to problematise the gender binary by paying closer attention to variations by geography, ethnicity, social class and - an area totally untouched here - sexual orientation.

Young people with an interest in computer programming or hardware have often been left to pursue these interests on their own, at home. In the UK, prior to governmental policy changes in 2012, most children and teenagers would not experience programming or computer assembly at school before the age of sixteen, by which point many would have opted out of ICT entirely. This situation has tended to benefit those with the most domestic support for such activities – namely those whose parents already work within the technical middle-class as computer programmers, web developers and network managers. Those whose parents worked in

technological roles during the 1980s and 1990s - although not necessarily those directly involving computers - would also tend to be most frequently exposed to paternal workplaces full of computers, before domestic computers were as commonplace as today. For example, Aaron's earliest memories of using a computer were while his father was conducting business selling audio equipment to a music producer, while Max built his first computer with parts sourced during his father's trips abroad while running a technology company. As such, the thesis has shown the value of inter-generational research as a way of identifying commonalities and contrasts over time, even within a relatively small geographical area.

An idea which underpins the theory of games as technological enculturation is that the domestic context is a key determinant in young people's engagement with - or rejection of - ICT or computer science. However, entry into ICT and computing courses remains low for boys as well as girls, while more British young people than ever play digital games of one kind or another. This suggests that there is some underlying issues with the theory in question. As argued by Elisabeth Hayes (2008) and reiterated in the work of DiSalvo and Bruckman (2009), any link between gaming culture, gender and technology can only be understood by looking at the more subtle and complex differences between different types of play and how these intersect with social identity.

One of the main difficulties with understanding the role of games as technological enculturation in the current moment lies in the rise of 'casual' gaming. Casual games stand in contrast to the more traditional 'hardcore' genres associated with consoles and PCs. The discourse surrounding 'casual' and 'hardcore' is well documented by Jesper Juul (2012) and dissected from a gender-critical perspective by Erica Kubik (2012) and John Vanderhoef (2013). It is casual games that have become associated with an older and/or more female demographic. For Hayes (2008) this means that while girls do play digital games of some sort, they are provided with less opportunities for technical learning, being that they tend to play simpler games on systems such as mobile phones, which do not provide the opportunity to produce content for games. DiSalvo and Bruckman (2010) further explore the limitations of broadly viewing games as technological enculturation through an exploration of the media consumption habits young men who do not identify as 'geeks' and who only play a relatively narrow range of popular console games. As identified in Chapter 3, there is a subsection of PC-gamers who can be described as 'gamer-tinkerers' for whom the technological enculturation theory holds truest and who, as Chapter 4 illustrated, might enjoy a close cultural fit with the expectations placed upon people in jobs requiring higher-than-average levels of computer literacy. This is not to say that all or many PC-gamers fall into this category. The purported relationship between PC gaming and computing is not simple or unidirectional, but rather complex and cyclical. PC gaming often demands certain types of knowledge about hardware - and it can potentially lead to computing activities such as programming, but this is not the case for every young person who games in this way.

This may explain why, among the older members of this sample group, those whose childhood stories revolved around playing games as opposed to making them tended to have jobs which were not related to programming but to hardware maintenance (Doug and Max, for example). As illustrated in the analysis of the younger group throughout Chapter 5, simply owning a PC and playing games on it was not an instant route into building, maintaining or programming computers. Rather, a constellation of possible informal learning or 'serious leisure' activities coalesce around PC gaming, but the likelihood of a young person engaging with these depends on a number of factors which will be discussed in the following sections. Hence, it is incorrect to see the learning experiences described throughout this thesis as solely

the result of technologies themselves or of the actors using them. Rather, different gaming technologies offer different opportunities for learning, and these are harnessed less or more under different social conditions.

This thesis has been concerned with problematizing some generalizations in existing accounts of videogame culture and broader computer culture. It does run the risk of moving from an over-emphasis on gender, to an over-emphasis on social class - albeit perhaps by using class in an intersectional way; understanding the shaping effect of social class upon different forms of masculinity. Given the ethnographic leanings of this thesis, no objective measure for social class was utilised, and I was wary not to portray any of my participants as over-privileged. Indeed, relations between social class and self-tutorage through 'serious leisure' are much more complex. For example, having a parent within the technical middle-classes might actually mean they spend less money on the latest technology and encourage their children instead to work with older, less user-friendly technology. This was the paradox evident in the classroom interviews discussed in the final chapter of data analysis. While young people from middle-class households may have more disposable income this does not necessarily transfer to having the newest or most expensive technology, namely because some middle-class households emphasise thrift while some working-class homes push against their socio-economic status by wanting the newest and 'best' of everything.

The gender-play-work relationship identified by scholars like Cassell and Jenkins (1998) becomes over-simplified when unsupported by empirical data and limited to a binary of normative expressions of gender with no mediating variables. As intersectionalist feminist Patricia Hill Collins argued, "a matrix of domination contains few pure victims or oppressors" (2000, p. 287), meaning that it is difficult to understand social power purely in terms of a dichotomy of dominating/dominated. Indeed, as hinted throughout some of the biographical accounts, there is still a sense that young people who become more deeply engaged with computers do so with the help of domestic privileges - such as having an affluent and computer-literate parent - while also incurring some loss of social prestige. As discussed in 3.3 (the LAN party where fieldwork was conducted) and further in 4.2.4 (the office LAN gaming mentioned by two different IT workers) events like LAN parties provide teenage and adult 'techies' and 'geeks' with an arena for activities which are still not regarded as cool or sociable in the same way as mainstream sports, popular music or television; still not something to be brought up in everyday conversation.

This sense of social difference was not something overtly expressed by the younger participants in Chapter 5 - although there was some variation in the degree of willingness to show enthusiasm toward computing as a professional field. But throughout the adult participants' accounts in Chapters 3 and 4 there was a sense of marking oneself out as unique through the 'techie' label during childhood and young adulthood, to eventually arrive at an enjoyable workplace to which other geeks and techies had gravitated. This sense of social difference continued to be expressed through the participants' accounts of day-to-day interactions with non-technical colleagues or clients, as discussed in 4.2. This resonates with Mendick and Francis' (2012) discussion about whether geeks, nerds and 'bods' should be viewed as socially abject or privileged; they may be both simultaneously. The dual status of geeks and techies as both socio-economically privileged and objects of cultural mockery and isolation perhaps goes some way to explaining the findings of Savage and colleagues (Savage, 2000; Savage et al. 2013) namely that 'techies' or the technical middle-class tend to be affluent and somewhat 'cultured' while also being relatively socially isolated when compared to the traditional middle-class.

6.2 Implications for Educators

6.2.1 Broadening Participation in ICT and Computing Education

The research here may have something to offer those hoping to broaden participation in ICT and Computing in schools, colleges and universities. Indeed, the 'techno-enculturation thesis' laid out in the literature review and expanded upon throughout this project is concerned primarily with how patterns of digital leisure impact upon educational trajectories. One issue that has been highlighted throughout is that ICT and Computing cover a relatively broad range of topics, but successive educational policy-makers have tended to emphasise one or the other of these subjects, rather than offering both.

Even though many of my research participants expressed some dislike of the pre-16 ICT education they had experienced, there was not any clear consensus as to what computing or ICT or computing education should entail instead. Rather, research participants tended to frame their preferences for an ICT or computing curriculum in terms of their own interests. Most of the computer scientists complained about a lack of programming in pre-16 ICT, while one graphic designer complained about the lack of creative or expressive applications of computer software. Many interviewees disliked ICT's emphasis on the Excel software and upon spreadsheets, while one recalled that she had not received any education in spreadsheets, and that this would have been useful in her current job as a data manager. Younger participants told their post-16 school courses gave them their first opportunity to actually see inside the computer - which revealed the limits of what they had been able to do at home compared to their hobbyist peers.

On the whole, these accounts do not necessarily provide any sort of useful direction for ICT teaching. Rather, they evidence the research participants' diverse orientations while suggesting that the uses of computers are possibly too numerous to be catered to within one subject. In addition, although it is important to properly delineate types of computer literacy (1.2.4) it is also clear that the participants who were cultural insiders within the professional field tended to place equal emphasis on hardware and software literacies, indicating the benefits of a holistic view of computing which, again, may be difficult to fit into pre-16 computing education.

Within the data analysis itself, these expressions of dislike towards pre-16 ICT were used more to provide insights into how the participants saw themselves in relation to computers. They also, however, highlight some issues that arise when trying to combine numerous equally valid perspectives on computers and computing into just one subject area. To contrast, the Australian education system splits computer-related courses into separate disciplines at secondary level; one associated with data management and programming, the other with creative multimedia. This approach brings its own issues, and has been criticised for channelling

boys and girls into stereotypically gendered interests in programming or artistic uses of computers (Abbiss, 2009). It is upon educators to constantly re-evaluate how computers are used and taught about at every stage of education, namely because computers are both a tool and a topic of study in themselves.

The observation that any use of games has tended to be limited to computing classrooms (explored further in 6.2.2) it perhaps reflective of a broader inability of schools to incorporate new interactive media within the rigid curriculum structures inherited from previous generations. Such issues are beyond the scope of the current study, but have been explored in greater detail by James Paul Gee (2003) and de Castell and Jenson (2004). Broadly speaking, videogames 'remediate' various older form of media such as literature, video, music etc. (Bolter & Grusin, 2000) meaning they potentially fit into any curriculum area while being fully accommodated by none, tending instead to be viewed primarily as a form of software.

The challenge for makers of educational policy is to better incorporate computing-related skills into other areas of the curriculum, so that young people who do not identify with the hardcore 'geek' culture of traditional computing may benefit through a sort of learning by stealth. Just as literacy and numeracy are not sectioned off into English and Maths, so we should start to consider how, for example, skills in basic programmatic logic could be gained in English Literature classes where young people are asked to construct interactive narrative texts. The challenge here is not, of course, simply one of policy, but also of convincing non-technical teachers the value of such an enterprise.

For those interested in promoting the representation of women or those from non-traditional ethnic backgrounds, the issue remains that informal learning is more readily available to some than others, a point made by Ellen Seiter (2008) as well as more specifically in relation to games (DiSalvo & Bruckman, 2010; Hayes, 2008). A prevalence of self-taught hobbyists within any professional field suggests to some extent that formal education has not been doing enough to 'level the playing field'. As evidenced throughout the data analysis, some of the hobbyists who were active during the 1980s received a parallel education in computer programming at their schools, but those who were at school age from the 1990s and onwards received an ICT curriculum focussed upon basic applications of computers for everyday administrative work and largely devoid of any computer programming. As a result, it is unsurprising that those who had taken some early interest in programming at home - before the age of 16 - would have a considerably large head-start over their peers once computing was introduced as an optional, post-16 subject and subsequent career-path. The situation outlined in Chapter 5 illustrates quite a severe gap between the point at which some young people have their first domestic experiences of 'higher' computing activities such as programming, networking or system assembly, and the point at which such activities are introduced to the remainder of school pupils. In British schools during the 1990s and early 2000s – before the introduction of the new computing-focussed curriculum in 2014 – the majority of teenagers will have self-excluded from computer-related courses before so much as glimpsing the inside of a computer or writing a single line of code; two activities archetypal to the hardware and software forms of computer literacy outlined in subsection 1.2.4 of the literature review. A curriculum focussed on the end-use of office software has arguably contributed to a perception of Computer Science as an insular and niche interest appealing only to those with some sort of natural aptitude.

Computing has tended to be the reserve of those from more socio-economically privileged homes, but particularly among the children of the technical middle-class; those

whose parents work in jobs requiring higher-end computer literacies such as programming or maintaining computers. The new computing curriculum, which demands that children begin learning basic computing concepts at the age of 5, may go some way to broadening participation in post-compulsory computing across UK schools, colleges and universities. It should at least help toward closing a knowledge gap between those who begin coding early at home, and those who lack the opportunity and support to do so. If a main reason for the gender gap in computing uptake is differential processes of socialisation around computers, primary and junior schools can play a defining role in balancing the gender uptake in ICT and computing at later stages of formal education. Future research should track the implementation of pre-16 computing in the UK and note whether the issues described here persist.

The predominance of hobbyists within the field of computing can, according to Margolis and Fisher (2003, p. 75) have the effect of alienating those who are not so singularly focussed on computers. Some young people are wary of entering a field whose existing participants seem obsessively focussed; where work and leisure show less of a clear distinction than in other vocations. However, I have also argued against characterising computing as having an 'image problem'. Labels like 'geek' and 'techie' refer to lived identities, not just media-generated caricatures of those who enjoy the company of machines more than people. Rather, the 'image' of the technology 'geek' may be related to the dispositions best suited to computing as an activity in itself. It is likely a pointless task to 'sex up' computer science, being as it is an inherently things-oriented field, and the appearance and mannerisms of many of its participants are simply reflections of the nature of the work.

As senior programmer and manager David put it quite bluntly in his interview; "It's not sexy to be in computer science, is it? Let's be honest. It's a box and wires and it's brown and beige and whatever, and we all care what's inside it, not what it looks like from the outside." In this case, as discussed particularly in subsection 4.2.3 and summarised in the adage "Never Trust a Programmer in a Suit", the expectation seems to be that many techies refuse present as glamorous or highly-socialized individuals precisely because they are so things-oriented. Although this forms the basis of many negative stereotypes surrounding the field of computing, there is perhaps still some truth to it. The specific things-orientation of computing jobs could explain why women have made more gains in areas such as Law and Medicine (Varma, 2007; Henn, 2014), which were previously male-dominated high-status, high-pay jobs that are nonetheless much more people-centred than computing (Lippa, et al., 2014). This perspective on gender and things-vs-people orientations veers dangerously close to supporting unempirical assumptions about innate traits based on biological sex. However, we may also use it to draw attention to the ways in which differential parenting and schooling practices reproduce a things-oriented masculinity and a people-oriented femininity. I have already suggested that the things-people distinction is not solely an issue of gender – although it appears to relate most specifically to gender – working-class young people have also been shown to be less likely to value and aspire to individualistic pursuits, and this may prevent a barrier to them in terms of engaging with activities which are 'geeky' and which lack social interaction (see 1.2.6). As always, a strong counter to arguments about the innateness of stereotypically 'masculine' traits lies in the strong variations we see in masculinities across categories of social class, ethnicity and sexuality - only the former of which has been foregrounded in this study.

At the same time, we should remain critical of the assumption that computer literacy is inherently valuable. As David Gunkel argues (2003, pp. 508-509), one unfortunate repercussion of debates about 'digital divides' based on technical literacy is a discourse in which users are normalised or celebrated, while non-users are treated as "deficient and lacking". Gunkel

encourages scholars of technology to better consider the ethical ramifications of any "apparently altruistic endeavour" which treats technical knowledge as a universal good. I argued in 1.1.3 that interventions into gender, education and technology raise important questions about the relative valuation of different types of skills and knowledge. The phenomena of girls' lower interest in computing is rarely discussed in relation to boys' lower levels of interest and achievement in language-related disciplines, for example. The valuation of forms of literacy – as worthy of study and promotion – is always bound up in broader social and economic considerations. Is it important to get more girls coding because so much of our social world is mediated by code, meaning that being able to program is a form of empowerment? Or is it an empowerment purely in the economic sense, because such jobs are presently better paid than others? A desire to encourage female participation in computing and STEM should not mean silence on the lower status and pay associated with the fields currently more associated with women. An intersectional perspective on gender and tech education also needs to consider the mediating factor of social class in determining both boys' and girls' relations to technology. 'Girls and STEM' (1.1.3) and socioeconomic 'digital divides' (1.2.6) need to be understood as interrelated issues, despite the emphasis on single categories of identity and oppression which are most likely encouraged by the brevity of journal articles and chapters in books.

As this thesis has been, for the most part, a study of those already in the field – namely men – it can offer little in the way of advice on how to address all of these issues. What it does reveal, however, is that for many of the adult tech-workers, the psychological pleasures and social identifications associated with being a self-tutoring 'techie' emerge relatively early in the biography: usually between the ages of 8 and 12. With this in mind, it seems as though interventions aimed at older teenage girls or 'non-geek' boys may be generally less successful because they are often aimed at young people who have already decided not to participate. This is not to say that someone cannot learn to program late, but the drive to program and to teach oneself to do so seems to emerge very early in some cases. As discussed in 4.1.2, the attitudinal consequence of early-adoption go some way to determining a person's 'fit' into an industry where the norm is, as Margolis and Fisher described it, a "myopic focus on computers" (2003, p. 75).

Out of the three women who were present in the workplaces and the LAN party where interviews took place, only one of them was a programmer, and she had learnt relatively late; her first mention of computing activities was during late adolescence, upon entering university. The observation that boys sometimes program to show off forms of technicity (Svelch, 2013; Dovey & Kennedy, 2006) to peers or parents needs to be considered in relation to gendered cultures of competitiveness (Walkerdine, 2006; Walkerdine, 2007) discussed in 1.1.3. It may be the case that the feminine avoidance of competitive behaviour in videogames described by Walkerdine is a result of socialization as opposed to some intrinsic difference. Nonetheless, the model of hobbyist learning described throughout the data analysis chapters is far from gender neutral, apparently best accommodating boys than girls, perhaps even when similar resources are available at home.

Here there is a continued relevance to studies of gender and leisure which illustrate how cultural expectations of gender often work to constrain girls' and women's access to and engagement with leisure activities (Haddon, 1990; Henderson & Dialeschki, 1991; Burke, 2004; Chess, 2011). In her initial response to what I have termed the 'technological-enculturation' theory of games, Elisabeth Hayes (2008) noted how gendered patterns in children's game-play mean that boys tend to have greater experience with and access to the forms of digital games which afford the most opportunities for technical learning. As Haddon noted in 1990, there was

always a "social side" to computing (p. 5) with boys gravitating to the hobby as something serious but fun, while girls' computing usually had to be "justified in terms additional to any pleasure which the activity might provide … the micro could not just be a 'toy' as [it] could for 'the boys'." (p. 13). Haddon's observation may still hold some truth today, and encapsulates one of the lasting issues surrounding gender and informal computer learning: namely the paradoxical situation where boys often seem to develop the kind of dispositions conducive to more "serious" uses of computers through a greater degree of early frivolous and pleasure-oriented engagement with machines. The phenomena of self-tutorage through 'serious leisure' (Stebbins, 1982; 1991; 2007) should be understood as deeply gendered, both in terms of boys' greater access to the associated leisure activities, and in the role played by typically masculine modes of competitiveness between young techies. The experiences documented here should not be used to justify a 'one size fits all' template for how technical learning is best achieved. Rather, they evidence one way that technical literacies have been achieved in a specific cultural milieu, and how these relate to a professional field more general in terms of professional identities and workplace cultures. In addition, this thesis has also brought to the fore the role played by platform-specific gaming tastes in determining which gamers get the most advantage in computing from their leisure pursuits; as discussed further in subsection 6.3.1.

6.2.2 One Major Caveat; Kids' Game Making is Not (Just) About Coding

While this thesis has foregrounded game-making and modding as potential entry points to computer science, it is important to recognise that such activities are not 'silver bullets' with regards technical learning. Nor should the technical, programmerly aspect of game-making be treated as the activity's only potential role in pedagogy. I came to this project with a childhood history of programming BASIC on microcomputers, as well as modifying PC games during my teenage years, which meant that it was likely that I would romanticise such activities in the accounts of others. However, whether or not such practices are presented in a way which over-states their significance is difficult to judge because that would require their significance to be quantified; something I am in no position to do given the nature of the data collected and the methodologies employed. It seems fair to say, however, that many young people are interested in the activity of game-making for reasons which go beyond – or completely sidestep – the activity of programming.

For the majority of adult coders I interviewed - even the four game developers – programming seemed to be an activity which was personally rewarding and enjoyable in its own right, regardless of the end product. My focus upon the accounts of technicians and programmers is likely to have missed a much larger group of people who make or have made their own digital games purely because they want to make games. This group are perhaps more likely to enjoy making analogue card or board games than the process of writing code. Because the thesis has focused on technological-enculturation roles of games as related to a specific professional field, it is in danger of missing numerous other reasons why young people make games, and the benefits they may enjoy from doing so while not necessarily developing any interest in programming as a broader activity outside of game-making. It seems most appropriate to say that making or modifying game content only opens up possibilities for further learning, which may or may not lead to a greater interest in computing. This is best illustrated by an example drawn from a specific game-making software; Enterbrains' RPG Maker series.

The RPG Maker programs allow users to make two-dimensional games in the style of console fantasy role playing games from Japan popular in the 1990s. Each instalment comes with a set of graphics for characters and locations, as well as music. The interface for setting up in-game events follows a series of flow-charts which do not require the use of any scripted programming language. However, recent iterations of RPG Maker (2004-) allow users to incorporate scripts written in Ruby. Ruby is a programming language with broader commercial uses outside of game-making, while many game-making programs or mod tools often use the developers' own in-house languages, such as Blizzard's JASS2 language in Warcraft 3 (2002) and Galaxy for StarCraft 2 (2010). Ruby scripts allow makers of RPG Maker games to alter the game engine to behave differently to the default design, thus allowing for a greater diversity of game types. However, the majority of RPG Maker users do not write their own scripts, instead downloading them from more knowledgeable Ruby-coders who make their work available online. Importing a script which does not do exactly what the user wants might prompt their first experimentation – e.g. changing some numbers here or there. However, the majority of users of RPG Maker will not go on to learn how to code such scripts from scratch. Rather, learning to code in Ruby is simply one possible outcome of using this software. As a platform, RPG Maker requires a specific coding language in order to do some things, and in doing so it provides an avenue for its users to learn one specific programming language and some more general programming concepts. Game-making software provides ample opportunity for learning – for 'technological enculturation' – but many users are more interested in making games and/or interactive stories than in the practice of manipulating the underlying code. This was evidenced by some of the discussions with teenage ICT students throughout Chapter 5.

With this in mind, it is necessary to reflect on the place that game-making has been given within school curricula. During my own time working at a British secondary school from 2008-2012, game-making software like Scratch was employed within the context of ICT classes solely as a way of introducing young people to the basics of computer programming. This is, indeed, the whole rationale behind the Scratch software (Resnick, et al., 2009) which was developed at MIT around 2003. Programs like Scratch, Stencyl, Game Maker Studio and Construct 2 allow users to make games without actually typing in any code, by using drop-down menus and flowcharts. What is being learnt in these cases is programmatic logic – the different types of variables which can be recorded and used by a program, how objects are manipulated and manoeuvred in game-space and so on. Ultimately, these programs work to democratise game-making precisely by removing the necessity of writing code as had been required of previous generations of game-makers like Lee – the game-developer interview who recalled programming Shockwave Flash games in the early 2000s. Preliminary research using codeless game-making software with 11-12 year old students has indicated that – contrary to some perceptions of girls as less interested in games - girls may actually achieve higher than boys at game-making tasks, particularly where narrative design is concerned (Robertson, 2012). As game-making software becomes more accessible, the activity of actually writing code becomes increasingly distant from many young peoples' experiences of making games. Even in the case of professional game-making software Unity - which usually requires developers to program in a traditional programming language such as C# or a form of Javascript – third-parties have developed software plug-ins such as Huton Games' playMaker which allow for a code-free game-making experience by representing game logic in the form of flow diagrams. The rise of code-free game-making tools destabilises the traditional link between programming languages and game development, increasing potential for game-making to become an activity used across other areas of the curriculum. This has consequences for what game-making can and should be primarily used for in educational contexts.

Game-making software has potential for much wider use than as an entry-level programming tool, and it is important that accounts such as my own – which document the role of game-making or modding in tech workers' learning biographies - are not read simply as calls to more strongly embed these activities into computing curricula. Hayes and Games (2008, p. 18) suggest that the current emphasis on using game-making primarily as a way to teach coding leads to a situation where students make half-finished or otherwise 'broken' games, and this may have the effect of turning them off of programming entirely; just as may be the case if art or music students are not taught how best to make work which is expressive or aesthetically pleasing. Games are arguably one of the more complex forms of software to produce, and while making games may be an attractive 'carrot' to many pupils, actually building a working, 'fun' game requires specific game design skills which ICT and computing teachers do not necessarily have to impart. Hayes and Games note that game-making is currently used in four ways; as a "context to learn computer programming" (p. 3) to "interest girls in computer programming" (p. 6) as "a route to learning in other academic domains" (p. 9) and in order to better understand design concepts (p. 13) with the first two tending to dominate to the detriment of the latter.

Another important perspective is that to call games 'software' is a fundamental misclassification. Casey O'Donnell, an ethnographer of game developers, puts forward the argument that digital games are widely regarded as a type of entertainment software, but are multimodal cultural objects made by diverse development teams, incorporating writers, artists and testers as well as programmers (2012, p. 34). Games are produced and held together by programming, but they are more often the product of software in the same way that literary forms such as books or poems are products of word-processing software. Unfortunately, as evidenced by Hayes and Games' review of literature on in-school game-making, educators tend to treat game-making solely as a form of software development; firmly within the realm of ICT and computing. Game-making has not yet escaped its perceived role as an attractive way to introduce programming; a way of 'sexing up' an otherwise maligned area of the curriculum. The technological enculturation perspective - most concisely summarised in Justine Cassell's claim that "computer and video games bootstrap computer literacy" (2002, p. 406) - currently finds its practical application in the unfortunately narrow scope for game-making activities in schools. If the examples reported throughout this thesis say anything about game-making activities in young people's lives, it is that these kinds of self-directed projects are diverse and have diverse motivations, often extending beyond – or sidestepping entirely - coding.

From autobiographical games about the impending birth of a new baby, to an aide for a sibling's maths homework, to a game made in unaccommodating software just to spite a teacher – all of these examples begin with an initial social spark. While such experiences should be acknowledged as crucial turning points in these individuals' computing biographies, they cannot necessarily be transplanted directly into formal curricula because such a transition destroys the self-directedness which gives them their power. While used here primarily as evidence of games as technological enculturation, the small first games described by interviewees are also examples of computer programming being used as a type of literacy - a way to explore, depict and thus negotiate the social world. As noted in subsection 3.1.2, such accounts illustrate the personal, diary-like and everyday quality of hobbyist game-making; an observation with resonates with Jaroslav Švelch's (2013) research into Czechoslovakian teenagers' home-made games in the 1980s. The games-as-biography perspective shows interesting overlaps with the literature on biographical research, where Winfried Marotzki argues that biographical accounts are most interesting for their ability to illustrate "individual forms of the processing of social and milieu-specific experience" (Marotzki, 2004, p.102). While beyond the scope of this thesis, the games-as-biography approach provides a much-needed antithesis to a focus on game-

making only as a form of technological learning related to programming - especially in a context where the activity of programming is decreasingly necessary for young people who wish to make games.

We should be wary of associating game development solely with computer science for the reasons given by O'Donnell (2012) but also because game design has a much broader untapped potential as a pedagogical activity across the curriculum. Concentrating solely on game-making as a way of teaching underlying computing concepts or languages is the contemporary equivalent of teaching only the technicalities of English structure and grammar while neglecting the expressive, communicative and persuasive qualities of the written word. Indeed, the emphases of Computer Science and English literature need not be so far apart in future curricula, as new tools such as Twine allow users to write expressive interactive fiction (Friedhoff, 2013) while tangentially providing opportunities to engage with programming concepts and practices. There is no good reason why games could or should not be developed within arts and humanities curricula; first as paper prototypes and then as digital versions, with basic coding principles as a secondary focus of such activities. It is even possible that such interventions would help to 'sneak' computer science into other subject areas and potentially alleviate the stigma attached to it by some students, recontextualizing coding as something with a broader application outside of computing and ICT classrooms.

Among my interviewees who had become software developers, some recalled making their first games because they enjoyed the activity of programming, but had little or no interest in games as adults. In contrast, others made games specifically because they wanted to make games as opposed to software more generally. This contrast in orientations is also present in Game Development as an educational field in UK universities, where some departments teach almost exclusively from a Computer Science perspective, while others prioritise game design, often using cards, dice, paper and pencils etc. to do so. To return to the example of Ruby in RPG Maker; the amount of RPGM users who learn to code Ruby is likely a very small percentage of the overall user-base. Among them, the group who learn a language this way and then go on to code professionally is likely even smaller, simply because the main impetus for any RPG Maker user to learn Ruby is in order to make better games. Expecting people who enjoy making games to enjoy software engineering is similar to conflating those who sculpt, paint or compose music with those who practice mechanical engineering and architecture. The activities are related, but not necessarily reducible to a single set of skills. Using game-making primarily as a route into computing programming seems akin to teaching fine art solely to inculcate 'transferrable skills' which might be used in painting and decorating while failing to capture the intrinsic appeal of the initial activity. It reduces a cultural activity with a humanistic, expressive and communicative value to its potential economic value on the labour market - even though, as Hayes and Games note (2008) the type of systematising design thinking learnt while designing games has a broad applicability to many jobs, beyond more obvious and concrete skills like coding and graphics-production.

In relation to the points made in 6.2.1 - more could be done by educators to harness the wealth of knowledge already available in hobbyist game-making communities. However, focussing on game-making as a form of computer science misses the bigger picture in terms of the cultural significance of games in young peoples' lives, while also keeping game-making and associated discussions within a seemingly insular computing curriculum, appealing only to a traditional computing demographic. Those with the relevant knowledge and experience owe it to future generations to spread in-school game development into the arts, humanities and traditional science subjects.

6.3 Implications for Game Studies and Game Development Researchers and Educators

6.3.1 Acknowledging Variations in Gaming Platforms and their Cultures

I have stressed throughout this thesis the need to pay close attention to the differences between gaming platforms in order to understand the pedagogical affordances of different technologies. This has helped to de-homogenise some of the earlier accounts of gender, gaming and technology and to more clearly elucidate the role that platform-specific player cultures have in mediating the kinds of technical learning which occur through or alongside gaming. While a connection between masculinity, gaming, computing and broader STEM subjects seems to exist, it is also clear that whatever advantage has historically been conferred to male gamers through their play habits is by no means universal. Rather, researchers interested in games as a form of technological enculturation need to take into account the special affordances of particular technologies alongside an empirical analysis of who plays on what machine. Both of these things are likely to change depending on the historical period, geographical location and cultural milieu under scrutiny. What is likely to remain relatively constant, however, is the disparity mentioned in 1.2.3 between 'open' and 'closed' systems in the terms of what can be learnt on them. A machine which is physically 'closed' in the sense of being a physically sealed machine does not provide learning experiences related to physical hardware. This is the case for most games consoles, the majority of smartphones and tablets and most Apple products. The same is true at the software level, where different systems allow for different levels of 'tinkering' with code. This distinction was made by 'PC exceptionalists' Greg and Max in 4.3.2 but Greg's account of system openness is worth reiterating here:

> Greg: I think it's a bloody shame that kids are being sheltered from exposure to raw environments which can be used to create your own life hacks and tools ... It's not so obvious how to get such an environment in Windows even, though it's possible. BAT scripts are a start, Office comes with VBScript, but now it's HTML and Javascript/JQuery. Windows 8 is even worse for letting you just 'play', and I hate that direction. You can go the extra mile and do it properly by installing IIS, PHP modules or your own Apache web server, but it's not so "Jump in and get coding" ready.

Again, what Greg is expressing here is not simply a generalized preference for PCs due to their capacity for creativity - he is also beginning to differentiate between generations of PCs and versions of operating systems such as Windows. As a general rule, personal computers are modular machines with games which are themselves often modifiable, while consoles are designed around easy-accessibility and social play, and their closed-systems tend to remove most of the potential learning experiences associated with technological 'tinkering' on PCs. Hence, analysis of the participants' gaming platform preferences took place in relation to adult interviewees' leisure gaming throughout Chapter 3 and also in the discussion of office gaming in subsection 4.2.4. Differences between those who played primarily on PCs and those who played only on consoles were marked among a younger group of respondents - the teenaged ICT students discussed throughout Chapter 5. This is the main difference at the level of the technology itself - the platform of play - and despite evidence showing that role of gaming practices such as modding in the development of technical expertise (1.2.3) the platform-specificity of these activities has rarely been discussed in the existing literature.

While acknowledging the differences between consoles and PCs at the level of design we should also pay close attention to who has the most access to what. The technological and social are always intertwined in accounts of technological enculturation. The point that PC games may have more to 'teach' in relation to technology is an important one when we consider that PC and consoles may be more or less accessible or popular to different demographics. These leads us to the second level of difference between PC and console gaming; the human level of player cultures. This aspect of difference within gaming culture is rarely discussed in relation to technological enculturation, with the exception of DiSalvo and Bruckman (2010). As noted in subsection 1.2.3 of the literature review, there appears to be some association between PC gaming and socio-economic privilege which extends beyond considerations of the financial cost of equipment. Young working class males such as DiSalvo and Bruckman's research participants - or the majority of the British youth discussed here in Chapter 5 - are less likely to have high-end gaming computers. While many of my older interviewees recalled early experiences of building, maintaining and programming their own computers, it would seem as though such practices are not widespread. Most young people - especially those from working-class backgrounds - are also unlikely to have parents who are able to provide them with learning experiences around this technology. These issues are discussed at greater length in sections 6.4.2 and 6.4.3 of the chapter, but at this point the important thing to note is the relationship between social identity and the type of games that young people gravitate toward and the possibility that they will incidentally learn something related to computer science during or around their gaming. While the first two data analysis chapters illustrated the role of gaming in the learning biographies of the IT-worker research participants, the platform-differentiation focus established in 1.2.3 and applied to interview data in Chapter 5 helps to illustrate how and why the apparently gendered nature of games-as-technological-enculturation does not necessarily apply to all - or even most - of the boys who play games.

In relation to the above issues, there is also a much broader issue within game studies where PC-specific games, namely massive online titles such as World of Warcraft (2005) are treated as representative of broader gaming culture, when they are most likely highly specific in terms of player demographics. This is a side point, but researchers who treat PC-specific gaming cultures as representative of broader games culture should take note of the information about PC-gamer socio-demographics outlined in subsection 1.2.3 of the literature review and further expanded upon during subsection 3.3.1 of the data analysis: PC-gaming is most often associated with a more technically literate and often economically privileged section of society.

For the large part, the gaming habits of the teenage boys I interviewed tended to be quite sociable and casual. The few in the class who had spent time teaching themselves technical skills were admired by some of their less technical classmates, but any time they spent playing on their PCs was time when they would not be able to play socially with the majority of the group. Their gaming may have some attitudinal link to their attitudes to technology, but it is an elite minority of predominantly male youth who gain more tangible academic advantages from gaming. In the cases of the 'PC gamer-tinkerers' within the adult and teenage sample groups, it seems that an interest in 'higher' uses of computers – whether related to software or hardware - develops alongside PC-specific game practices rather than being directly generated by the gaming itself. The data discussed in Chapter 5 was collected from suburban schools in the UK in areas which are predominantly white but also experience high levels of social and economic deprivation, and this may have had an effect in terms of the distribution of different orientations to technology.

As several of the younger participants suggested, home laptops and computers were available but were used primarily for social networking or homework, while consoles were the main play platform. As one participant - Eli - put it: the thought of using a computer to play games has probably "not entered the minds" of many of his friends. The degree to which social class structures young people's interactions with digital games has been a relatively underexplored dimension of player-oriented games studies; perhaps because such studies in the American context deal with player cultures where gender, 'race' and socioeconomics all intersect in ways which are impossible to disentangle. It may also be the case that the effect of social class is deemed too obvious; the assumption being that class is reducible solely to economic capital and that children of richer parents always have the most expensive technology. However, the Bourdieusian perspective taken throughout the thesis - and unpacked further in 6.4.3 of this chapter - contends that the relationship between social class and technology is not nearly as simple. Particularly among the older respondents, we have examples of earliest home computers purchased second hand or "rescued from a skip"; the key factor here being not financial cost but the presence of gatekeeping older family members who understood the potential value of these machines (usually based on some interaction with them in the workplace).

In addition, as we have seen, new or expensive technology does not necessarily mean richer learning experiences, and parents knowledgeable in a field may exercise types of thrift in terms of trying to direct their children toward the learning experiences they deem best. Take, for example, the Raspberry Pi kit computers, which cost just £20-£50 but which are intended to provide young people with home 'tinkering' experiences similar to those had by hobbyists before the advent of visual operating systems such as Windows. Because of its appeal to a demographic of older computer hobbyists who are now parents, the Pi has been disparaging described as 'a mid-life crisis' by some critics (Rockman, 2012). The Raspberry Pi has the potential to increase children's interest in computing, but it is impossible to predict its potential impact in any meaningful way.

Another cultural aspect of the specificity of PC gaming culture, beyond the socio-economic determinants mentioned so far, is that PC gaming has its own broader sub-culture, visible online. Subsection 3.3.1. described the 'Glorious PC Master Race' subculture - located most notably in a forum with over 400,000 accounts attached to it. It was necessary to explore the sorts of techno-elitist discourses which fans express -ironically or otherwise- to position their group 'above' console gamers. Despite the 'PC Master Race' term originating around 2008, this thesis is one of the first pieces of games research to touch upon the subculture and the ways in which broader PC gaming culture might shape the more local meanings of gaming platforms. Thus it was necessary to document and analyse the 'PC Master Race' discourse as it appeared online in order to properly analyse some of the research participants' discussions, particularly in the case of group interviews where subcultural terms like 'console peasant' began to surface.

By focussing on a sample group largely composed of boys and men, it has been possible to further illustrate a point made by Diane Carr (2005) and Jenson and de Castell (2008) in relation to girls - namely that the observable differences in relationships to games - which are often uncritically treated as evidence of innate gender differences - are strongly mediated by both peer-group norms and by conditions of domestic access. What we find continually in such studies is that prior access - to both technology and supporting, knowledgeable adults and peers - is likely to be a much stronger determinant of young people's trajectories of technological expertise. It is the home where a large portion of young people's

gaming occurs, and - for the self-taught hobbyists in computing - where many computer skills are learnt which set them apart from their classmates. Existing empirical work into educational gaming practices rarely foregrounded how specific most of these practices are to the personal computer. This is particularly problematic when considering the statistical association between PC-gaming and socio-economically privileged youth. Technical differences between gaming consoles and PCs inform local and global discourses surrounding PC-specific gaming culture, while also informing the identities of many players. The thesis has paid close attention to these issues, working to synthesise the existing body of research on gaming as technological enculturation with the materialist, platform-centred approach suggested by Laurie N. Taylor, (2007) as well as Bogost and Montford (2009).

When taken as a whole, much of the existing literature seemed to indicate that 'gaming' as a general hobby was providing boys with a general head start at computer literacy. However, on closer inspection it seems as though PC gaming has tended to provide middle-class boys with a specific a set of opportunities which may translate into a head start. Such opportunities, and the conditions of domestic tech access which define them, seem to be strongly determined by parental attitudes, in the sense that many of those who had been active computing hobbyists during childhood or early teens tended to have relatives - usually male - who were either hobbyists or who worked in computing or related fields. By focussing on a sample group largely composed of boys and men, it has been possible to further illustrate a point made by Carr (2005) and Jenson and de Castell (2008) in relation to girls - namely that the observable differences in relationships to games - which are often uncritically treated as evidence of innate gender differences - are strongly mediated by both peer-group norms and by conditions of domestic access. Simply playing on a PC as opposed to a console is not enough to ensure an interest in or aptitude for computing. However, the strongest caveats relate to the issue of how such findings may be interpreted and applied in a pedagogical context. These practical caveats were laid out in 6.2.2.

6.3.2 Understanding Young People's Game-Development Aspirations

Some of the discussions with the young people from the academy schools were surprising, insomuch as I had would expect young people expressing an interest in a creative field to be practicing something related to that field as a hobby at home. This did not appear to be the case, and instead I encountered half a dozen young men who all had access to the tools to be working on small gaming projects, but who had either never tried making games, or given up at the first technical hurdle. Ironically, the young people who expressed the most interest in programming as an activity in itself were those who had the most domestic experience of making games. The claims about wanting to work in the games industry reported in 5.1.2 should be viewed with caution, not least because many of these interviews were conducted in friendship pairs - a methodological limitation which may have increased the chance of these responses being of a performative nature, having more to say about what tech jobs the students thought were 'cool' than any genuine plans for the future.

One of the recurrent arguments within this thesis has been that the platform-specificities of different gaming cultures are too frequently underplayed. In terms of games themselves, platform studies can illustrate how – as many designers know – gaming platforms and control interfaces go some way to shaping the type of games that are made. However, more importantly

in relation to the theory of technology-enculturation; different gaming platforms have different levels of openness, and it is this which appears to play the strongest role in determining which groups of players have the most access to game development. Although some console games allow a degree of in-software level design or rule customisation, children and teenagers with gaming PCs are more likely to have access to the types of activities which have traditionally allowed early experimentation with the technical aspects of game-creation. They may also, in some cases, have a greater degree of access to a broader range of smaller and/or older games - although this may be changing with the advent of 'arcade' and 'indie' online game marketplaces on the main console platforms. In addition, the findings of Chapter 5 indicate that many with a stated interest in the games industry have little experience of games beyond the most popular and highly funded commercial games. All of these factors may determine the experiences and expectations students bring with them to courses in Game Development and related areas.

6.3.3 Implications for Scholarly Practice: the Value of 'Leisure' and 'Career' as Concepts within Studies of Gaming Culture

Section 1.2.2 described computing as one field in which more traditional, dichotomous definitions of 'work' and 'leisure' were subject to collapse, and this seemed to be confirmed to some degree by the discussions of career transitions and workplace cultures throughout Chapter 4. Many of the interviewees find in their present occupations the perfect accommodation for childhood interests. Many of them are paid to do a job which is largely an extension of a hobby - something they would do regardless, if money were not an issue to them. Their job fulfils and makes use of psychological dispositions which have been with them since childhood; largely they enjoy making things, puzzling things out, and teaching themselves. They are what Stebbins describes as occupational devotees; those for whom careers of leisure and work are inextricably fused.

Defining different types of gaming as 'casual' or 'serious' leisure re-evokes some of the problems with the oft-gendered 'casual' and 'hardcore' framing of games, but in this case it has also helped to illustrate cases where the types of informal learning associated with career-acquisition may take place the most. Characterising gaming as a leisure activity more generally helped to draw such connections between tech-related work and tech-related leisure, rather than looking at specific instances of gameplay. It also allowed for a fruitful discussion between game studies (often concerned with either games themselves or particular player cultures) and the an older set of leisure-studies literature which is well-equipped to theorize concepts such as 'hobbyism' and the types of informal learning associated with it.

As noted early in the literature review, the fact that so few young people -boys included- choose to pursue a career in technology must mean that the purported role of games in technological-enculturation is much more specific and nuanced than previously described. The 'serious leisure' activities that sit at the intersection of gaming and computing – building computers, creating game content, coding websites for game-related groups and so on – are not undertaken by the majority of gamers, for whom gameplay is much more a casual, social activity. The serious/casual distinction in Stebbins' framework is not meant to describe some objective quality of the leisure activity itself – a judgemental topography of whether an activity is frivolous or educational - but rather the subjective ways in which leisure is understood by its participants. Although the thesis has focussed on computing-related 'serious' forms of gaming, there are of course non-technical forms of serious leisure gaming, such as those who play competitively, those who write about games and so on. In this case, Stebbins' framework is

useful insomuch as it helps to unpack the subjective identifications which underpin how young people relate to gaming and games platforms in different ways.

Across the age groups studied, the 'tinkerers' identified throughout this thesis best fit Stebbins' theorization of 'serious leisure' in relation to computer gaming. Their gaming provides a sort of hub for learning about computer hardware and, in some cases, programming. This leisure orientation is also, in some ways, a product of the dominant technologies of the time, with 1980s programmers often interested in games as programming projects, while those born after the mid 1980s tending to have been exposed to hardware first. 'Tinkerers' may be hardware or software focussed, or a mixture of both, but they share commonalities in their perception of technological problem-solving as intrinsically rewarding; a subjectivity which informs their career choices, as well as their self-identification and perception by others as expert techies or 'computer people'. In the case of younger PC tinkerers like those discussed in Chapter 5, programming environments have been less obviously available than they had been to hobbyists active during the 1980s and early 1990s, meaning that the younger interviewees' entry into hobbyist computing has generally come from building and maintaining computers' physical systems as well as networks used for multiplayer gaming. As we move into a world where closed proprietary systems like Apple iPads move into more classrooms, there will most likely be an ongoing struggle between competing conceptions of computers-as-tool (typified by UK ICT education from the 1990s onwards) and computing-as-subject; emphasised in UK schools before 1990s and in the second decade of the 2000s.

While it would be incorrect to suggest that everyone working in computer programming is from a hobbyist background, the discussions of organizational culture in Chapter 4 did seem to suggest that the hobbyism was common and respected enough to be part of the expected background of new employees. For example, Neil recounted interviewing industrial placement students and using their "projects from home" as a main way of differentiating them because "they'd all have the same experience because they'd all pretty much learnt the same things" at university. Similarly, there was David's argument that a "proper" programmer would be self-tutoring constantly outside of work hours. The predominance of hobbyists within a field suggests a collapse of work and leisure, and this makes entry increasingly difficult for those who have not come from a background of leisure-learning; such as the majority of the ICT students discussed in Chapter 5.

The thesis has thus been able to account for a specific period between 1990 and 2010 where computing education in the UK was replaced with a Microsoft-Office-centric ICT. The outcome of this was a computing workforce who had, lacking the opportunity to program at school during the majority of their school years, often had their initial experiences of computing informally, in a domestic setting.

6.4 Reflections on the Methods and Theoretical Framework

6.4.1 Reflections on the Biographical Method

This subsection will focus upon the most salient findings with regard to the methodological stance outlined in Chapter 2, reflecting upon some of the limitations of the study in terms of

validity and generalizability. Firstly, there is the issue of positionality: the role of my 'self' in the collection and analysis of data. My own history as a gamer, and someone who has spent time around gamers of various ages may have coloured some of the findings regarding gaming culture. For example, my reading of PC gaming culture put forward in 3.3.1 relies on some personal knowledge that existed before this research project – such as an awareness of the semi-ironic 'Glorious PC Gaming Master Race' label. I have tended to place myself more in the 'omnivorous' category of gamer described in 3.3.3 as I have no set preference for play platform, and enjoy things about each. Naturally, these factors can influence the sorts of interpretations made by a researcher who is also a gamer, although the explanation of the material differences between platforms (1.2.3) and of PC gaming culture (3.3.1) are informed by empirical data. Games and the surrounding culture pose issues to researchers because those with the appropriate level of background knowledge to understand what is happening may also lack the detachment required to analyse in a fair and generalizable way. My data collection and analyses are products of my own identity as a British, male, white 'gamer' with some basic experience in hobbyist computing and game development, who had access to research participants who share many of the same experiences. As Cho et al. (2013) argue, intersectional social research is essentially an ongoing collaborative endeavour between researchers from different backgrounds, with the goal of developing a large body of work which understands the social world from a variety of different positions.

There is also the issue of what exactly constitutes data with regard to this specific research topic, and how it might be best collected and analysed. Given that I have drawn so heavily upon Pierre Bourdieu as a source of theoretical insight, it might make sense to follow a quantitative route typical of Bourdieu's work; taking a much larger number of research participants and surveying them on tastes, preferences and cultural knowledge in order to analyse this in relation to their socioeconomic backgrounds. It is true that some of the research questions may have been adequately answered by conducting large scale surveys which looked at educational and work careers in relation to a list of game-related practices that subjects had participated in. At the same time, the more small-scale, qualitative approach taken here has provided a rich account of the similarities and diversities within a purposively-sampled sample of workers and students. Issues regarding the appropriateness of methods and research positionality also coalesce in the fact that I was perhaps best equipped to conduct an 'on the ground' and 'face to face' survey of gamers and computer geeks, insomuch as I was thus able to operate as a cultural insider to some degree. The strength of this approach lies in its ability to uncover unexpected minutiae that may have been missed by large-scale data collection, such as the nature of specific games and programs made by participants. In this sense, it is more exploratory, but points toward the potential for further research in this area, whether from a qualitative or quantitative perspective.

It is true, however, that large scale surveys which apply Bourdieu's focus on culture and class to gaming are few and far between; with notable exceptions being conducted in Norway (Hovden & Klevjer, 2012) and France (Rufat, et al., 2012). Both of these illustrate the ways in which working class masculinities may play differently (on the couch, more 'casually' and socially in-person rather than online or at LAN parties) than their middle class peers, and may thus be further from the 'computer geek' archetype. Given that this study adopts the notion of a 'technical middle-class' from the work of Savage and colleagues (Savage, 2000; Savage, et al., 2013) some of the claims offered throughout my own analysis may see future investigation through further analysis of the media tastes of the technical middle-class in comparison to the population at large. This would help to test the veracity of my claims about the role of PC-gaming in processes of cultural reproduction within this group.

Throughout this project I have tried to balance an understanding of my informants' accounts as 'true' with an expectation that such accounts are in some way performative of beliefs and values. This stance was laid out in section 2.3.4 in terms of 'analytical pluralism' and the metaphor of two 'lenses'; attitudinal and materialistic. As Keither Taber (2008, p. 70) argues, such an approach is appropriate in cases such as this, where "each theoretical perspective only provides a partial picture of the process being studied and where the distinct perspectives may be considered to be congruous". The Bourdieusian theoretical framework used throughout the thesis sees the material and attitudinal dimensions are co-constructive; material conditions produce and reinforce attitudes. Embodied dispositions – habitus – are viewed as products of socio-economic positions. As such, respondents' expressions of beliefs and values were constantly analysed alongside what I knew about the material conditions of their upbringings; for example in terms of what technologies were available to them during childhood and under what conditions. An analytical pluralism which is able to tackle both subjectivity itself and its relation to materiality is necessary when dealing with issues related to the 'digital divide' which relates not only to conditions of material access but also how these relate to long-term dispositions such as (dis)comfort toward specific technologies or uses of technologies (Andrews, 2008; Seiter, 2008).

6.4.2 The Value of a Cross-Generational Perspective

The thesis has employed a uniquely cross-generational perspective, both in relation to the existing literature that was reviewed and the fresh data which was collected and analysed. This has contributed to the existing body of work on games as a form of technological enculturation, while also serving to highlight continuities and changes in the relationship between gaming and hobbyist computing since the entry of digital games into British homes.

This perspective invites us to further question the degree to which interviewees' experiences and expectations are mediated by historically-specific cultural factors. Neither games, nor the process of making them, are static cultural monoliths. As noted in the previous section, software and processes for making games are changing constantly, and in more recent years this has meant a gradual erosion of the need to 'program' games in the traditional sense of writing command-line code. But even differences in the design, presentation, financial cost and graphical realism of games of commercial different periods means potentially different expectations. For example, teenagers interested in making games in 2015 have influences and expectations based upon a much more established games industry than in 1985. A commercial game produced in the 1980s would often have been made by small teams with small budgets, often using the same BASIC language available to all micro-owners. In terms of content, games genres were not yet fixed, meaning that many games of the 1980s were – as school technical Doug put it - "weird and wonderful" with each game being "very much the first of its kind". In contrast, young people in the 2000s and beyond approach hobbyist game-development with expectations of games similar to those they already play, which can often mean graphically realistic projects made by teams of over one-hundred people, costing in excess of 10 million US dollars (Waters, 2005). In other words, as the industry has matured, it may be the case that young people's hobbyist game-making loses the biographical, every-day quality it had for earlier generations.

The popularity of independently-developed games such as Minecraft (2009) may represent a reversal of many young gamers' tastes; a turning away from the games industry's focus on big budget graphical realism in favour of player-creativity and experimentation. The impact of smaller 'indie' games on young people's own game-making is yet to be seen, and it would also be worth exploring which groups of young people actually engage with 'indie' (smaller-budget, independently developed) games at all. Titles like LittleBigPlanet (2008) and Mario Maker (2015) put players in the position of a level designer. This turn towards user-generated content has been described as "Gaming 2.0" (Djaouti, et al., 2010) and has additional ramifications for how young people engage with game-making as a practice. However, there was little evidence of modding or preference for "gaming 2.0" titles, even among the younger sample group who aspired to work in the games industry.

Take, for example, the sizeable group of boys in Chapter 5 who stated 'game developer' as a career goal but who only played big budget console games. For most of them, small 2D games would be something they could realistically begin making on whatever shared laptops were available at home, but only those with gaming PCs would have the hardware required to make 3D games similar to those they are used to playing. There seems to be a considerable gulf between the type of games young people are exposed to and what they are realistically able to make, and among the young people I interviewed, none of those who aspired to work in games had made a game using old-fashioned card, let alone one held together by code. All of these issues are likely affected by the fact that the majority of the young people available to speak about going into post-compulsory ICT education were boys from less socioeconomically privileged backgrounds whose upbringings were not necessarily comparable to those of the older respondents.

As many young people express an interest in making games, educators in this area should keep a close eye on their students' gaming preferences and how these prefigure their expectations of exactly what is meant by terms like 'game design'. The thematics of young peoples' games - what they choose to make games 'about' when given the opportunity - is a potential topic of future research, along with examining the degree to which their existing gaming tastes pre-figures their attempts at game-making. It may be the case that experimental indie titles such as Jonathan Blow's Braid (2008) are either unknown to most young people, or dismissed as pretentious and avant-garde. Are there specific social demographics which have a greater affinity with low budget 'indie' and 'art games' and, if so, are these more likely to begin a career of game development with more attainable aspirations? The platforms upon which young people play may also have some determining effect upon the types of games they aspire to make, which in turn mediates the achievability of any aspirations they have regarding making games as a career. It is one thing to point to a creative game like Minecraft as a way for young people to gain technical proficiency; another to fully understand which young people are reaping what benefits from such a game in the home.

Hobbyist learning cannot be removed from the context in which it occurs. It is crucial to acknowledge that the types of hobbyism reported throughout this thesis are self-directed and, as such, thoroughly at odds with more proscriptive, teacher-centred classroom activities. The pleasure and sense of self-worth and identity derived from hobbyism is also a product of the relative rarity of the skills involved. Literacies, in this sense, can form the basis of social hierarchies of 'cool'/'geek'. As Jaroslav Švelch recalls in his account of the high school programming scene in 1980s Czeckoslovakia, such activities were a way of evidencing a type of technicity - of proving one's technical ability to peers and to oneself. In a context where few can program, such knowledge becomes a form of cultural currency. Such is the nature of cultural

capital in Bourdieu's theoretical framework: a type of skill or knowledge can only be appropriately characterised as cultural capital if it is able to offer its owner a form of social 'distinction' by nature of its relative rarity (Bourdieu, 2000, p. 49) and to be convertible into social or economic forms of privilege. To return to the analogy between computers and cars made by one participant; 'motorist', 'car mechanic' and 'automotive designer' all represent different forms of technicity. The former of these is the most common, while the latter of these entails forms of cultural capital which are rarer and therefore more readily convertible into larger amounts of social and economic capital. Thus, we should consider how the hobbyist scenes explored here and in other studies are historically been contingent upon a lack of formal provision, in the sense that participants derive their sense of self-worth from the fact that the majority of their peers do not participate in the same activities. This will be an interesting issue to track as the new computing curriculum becomes established in the UK, and children begin learning to code as early as age 5 with the help of technologies such as the Raspberry Pi.

The cross-generational perspective has also served to illustrate certain continuities in the early biographies of 'techies' born in different periods. For example, older coders like Neil, David and Greg were all active during the 1980s. They taught themselves to program, initially making small game-projects before gradually moving on to study and/or work in the field. As discussed in 4.1, their hobbyist backgrounds made them a good cultural 'fit' with workplaces where self-tutorage was an expected norm; an ethic they pass on in their expectations of junior staff. Similar histories were visible in the biographies of younger participants in their 20s, such as Lee and Max. Although Lee and Max's biographies of informal learning happened in different orders – perhaps due to the rise of modular PCs in the 1990s and the death of 1980s BASIC microcomputers – they still entered their respective fields with the same 'ethic of self-tutorage' identified in the accounts of the older participants. This ethic is part of the habitus that gives workers in the field of computing a sense of social and psychological similarity, and in many of the accounts this appears to be a central aspect of the 'techie' identity. Although some of the older respondents believed that the rise in university degrees for Computer Science had eroded the prevalence of the traditional hobbyist, most of the respondents in their 20s had been hobbyists during adolescence and taken a university course.

6.4.3 The Continued Relevance of a Bourdieusian Framework

The thesis has worked within a theoretical framework adapted from Bourdieu's concepts of capital, social distinction through taste, habitus and field. These concepts have been applied in previous studies of computing as metaphors for understanding the socio-cultural mechanisms which reproduce gendered, racialised and classed forms of privilege in relation to computer-based work. More recently these terms have been adapted to studies of player cultures in game studies (2.2.7) and part of the unique contribution of this thesis has been to synthesize related applications of Bourdieu to both computing and gaming culture. This synthesis should help us to better understand the connection between these fields as implied within the existing work on gender and gaming as technological enculturation.

Bourdieu argues that - in terms of determining young people's eventual socio-economic position - the effects of formal education are secondary to the ways in which parents from more privileged sections of society pass on knowledge and dispositions to their children at home. In previous generations, the traditional middle-classes policed their children's leisure time in such

a way as to cultivate a knowledge of arts and the humanities which would hopefully provide them with advantageous positions in school and later in the job market. What appears to have happened since the advent of the home computer is that parents within the technical middle-classes replicate their class positions in a similar manner, by buying particular technologies and encouraging particular types of use. This is evident from the biographical accounts of predominantly male tech workers who - despite an age gap of up to twenty years - offer similar stories of technically proficient and enthusiastic paternal figures encouraging them to build machines or program them.

These accounts evidence a form of cultural reproduction; a key focus of Bourdieu's work and in studies of youth transitions. Cultural reproduction describes the ways in which parents transmit classed cultural values and types of knowledge (cultural capital) to their children, in ways which often reproduce their socio-economic status. For example, Bourdieu argued that middle-class families gave their children a form of 'head start' in school by encouraging an interest in the arts and humanities at home, thus providing them with resources that were clearly in line with the dominant culture promoted in the curriculum. As Ken Roberts puts it;

> Reproduction is a major process, if not the main process, that youth researchers are required to investigate. This is because youth itself is a process, a transitional life stage, during which individuals' lives change constantly. The core task of youth research is to identify patterns in these changes and thereby discover how children from different backgrounds reach different adult destinations. (2009, p.20, emphasis added)

However, it is not enough to simply illustrate the continuities between older, print-based literacies and computers in terms of their role in cultural and social reproduction. This study has identified the sort of patterns described above by Roberts; changes occurring between childhood and adulthood in the lives of those who end up in the professional field in question. But it has also mapped out the ways in which domestic practices of cultural reproduction may operate within a relatively new class faction which is not adequately described by the generic term 'middle class'. I put forward the argument that the technical middle-class has its own practices of cultural reproduction which are specific to computing-related pedagogy. Indeed, Mike Savage - who coined the term 'technical middle-class' in this context, argues that this group are culturally distinct from the traditional middle-class in that they are more aligned with science, technology and engineering and not with arts and humanities (Savage, 2000; Savage, et al., 2013). There can be seen strong continuities with traditional middle-class culture - as Ellen Seiter puts it in her comparison of the computer to a family piano as an object of domestic cultural practice (Seiter, 2008). These Bourdieusian perspectives help to draw connections between lay-term labels like 'geek' and the ways in which gendered identities are partially constituted through class.

However, while having parents heavily interested in history, art or literature might translate to a simple 'head-start' at these subjects in school, the relationship between technical parents and the incumbent ICT curriculum has been less simple, namely because ICT in British schools has focussed primarily on administrative uses of computers in ways which sideline the 'higher' computer literacies. As a result, a young person with a higher-than-average level of computer literacy may also be at risk of disengaging from classes which are pitched too low (Carter, 2006). In this sense, domestic, hobbyist learning does not necessarily translate into

academic advantage unless these skills are valued and rewarded within the school at lower levels. For many of the research participants, this was not until they were aged 16 or above, because the curriculum did not allow for computing activities such as programming to have any value at lower levels. Such negative experiences and perceptions of formal ICT education were a common theme in the accounts of interviewees who had taught themselves at home (4.2.1). However, the theme of 'feeling special' for having disproportionately more knowledge than peers also plays an important role in whether people identify as 'techies' - something illustrated throughout section 4.2.

Bourdieu's emphasis on cultural taste also helped to describe and analyse some of the existing tensions between platform-specific gaming fans; namely when PC gamers employ discourses of techno-cultural elitism - typified by the 'PC Gamer Master Race' meme and subculture. (4.3.1-4.3.2). Such an analysis of broader discussions within digital gaming culture was necessary in order to contextualize the face-to-face conversations analysed in Chapter 3. Looking at broader discussions around gaming helps to illustrate some of the beliefs and values attached to different platforms which are bound up in people's everyday uses of technologies for work and play. The idea that consoles may be harmful to young people's potential for creativity was expressed overtly by only two of the respondents, but similar themes of consoles as a more 'dumbed down' platform were visible in the online discussions. The position I have taken throughout – in initially describing the differences between platforms in 2.2.3 and notably in the analysis of the teenage ICT students in Chapter 5 – to some extent supports this form of elitism. In short, I have give the impression that PC-gaming is in some way 'better' - at least in a pedagogical sense when related to technical learning. But at the same time, participants expressing a preference for PCs over consoles rarely show a consideration of the barriers to entry, even as they express why their platform is 'better'. Even in the gaming press, cost-analyses of the two platforms can be unfairly skewed toward making high-end PC-gaming seem cheaper than it is (see 2.2.3) and the importance of having confidence and knowledge about how to maintain a computer for this purpose is never addressed. The implication is that the majority of young people who opt to play on consoles only have made a 'choice' when in reality their gaming practices and tastes are heavily mediated by forms of economic, cultural and social capital. Hence the 'gaming capital' theorized by Consalvo (2007) as a general term for the type of knowledge associated with identifying as a 'gamer' is multidimensional in the sense that being a PC-gamer may entail a specific type of 'gaming capital' which is itself the product of these more traditional Bourdieusian capitals and which may in turn lead to higher levels of computer literacy – forms of cultural capital which are integral to technical middle-class professions. Young people's earliest engagements with technology are heavily mediated by parents in the domestic environment (Itō, 2009; Seiter, 2008; Andrews, 2008) meaning that the forms of 'technicity' and gamer identity that they develop are bound up in older relationships between social class and practices of parenting (Lareau, 2011; Irwin & Elley, 2011; Vincent & Ball, 2007). Sociologists of gaming culture should be heavily critical of the somewhat widespread idea that platform preferences are merely a personal choice. Indeed, one of the reasons that some gamers become 'fanboys' for one particular platform or system may be a perceived need to defend and rationalise decisions made about the allocation of limited financial resources.

By applying Bourdieu to these platform-specific gaming preferences, it also becomes possible to understand such preferences and their expressions as forms of social distinction; a way of positioning oneself favourably in relation to others. Hence, the voracity with which so-called 'fanboys' tend to defend their chosen platform (PC vs console) or specific console. In terms of the PC, such distinctions take on a particularly technologically-elitist flavour because

they are ultimately about casting oneself as more technically able. At the same time, many may reject the PC-gamer identity because it is associated with being more 'nerdy' and less sociable. Consoles are a more easily accessible machine and have tended to be associated with more sociable play - in terms of playing with real-world friends or family in the same room. As such they have a broader and more general popularity, and, as suggested by Helen Thornham (2008) are perceived as less 'geeky'. In this sense, most young people's engagements with digital games on consoles, mobile phones and web browsers better fit Robert Stebbins' understanding of 'causal' leisure, regardless of the genres being played. The idea that PC-gamers are in some way more 'serious' about their leisure activity – making it closer to a 'craft' than a hobby – and the fact that such a taste is mediated by forms of cultural capital, fits with Stebbin's understanding of serious leisure's' "built-in class bias" (2007, p. 62). More 'serious' uses of gaming - as a way to evidence one's ability to build high-end computers, or to use such machines to actually make new game content - are activities which are more difficult to access for those without the necessary economic capital or a network of people with the relevant expertise to provide educational scaffolding. Max's account in Chapter 3 of using £500 of pocket money to buy his first PC, built using parts sourced by father, provides an extreme example of this. The point is not that such privilege is bad in itself, rather that the undercurrents of technological elitism identifiable in broader PC-gaming culture may often emerge from a type of ignorance; the 'console peasants' (as console players are semi-ironically referred to) are depicted as having misguidedly 'chosen' to play the way they do, rather than both groups having their tastes structured by forms of cultural, economic, and social capital.

Bourdieu's concepts were also useful for understanding the concept of 'field' as applied to computing as a career spanning education and work. The Bourdieusian use of 'field' is not dissimilar to the common usage of the term to refer to a general professional, academic or otherwise cultural area. In Bourdieu's terminology, field and capital are interrelated, because specific fields have their own expectations of what forms of capital an ideal participant will have. One of the things to emerge from a Bourdieusian reading of computer literacy is that computer literacy is not the only form of cultural capital governing the field of computing, but also the valuing of hobbyist-like disposition toward self tutorage (discussed throughout 5.1). Section 1.2.6 of the thesis used a Bourdieusian framework to – using the secondary evidence gathered from existing literature on the subject – construct a model for understanding what type of 'habitus' might make an individual 'cultural fit' with the prevailing culture in the field of computer science, illustrated by a diagram Fig. 3. This posited that computing activities such as programming require a disposition which is individualistic and 'thing' oriented as opposed to communitarian and/or 'people' oriented. As such, the existing evidence suggests that in terms of early orientations at home and school, it is likely that both girls and working-class boys are likely to be repelled by computing because both groups are expected to be highly sociable and group-oriented; a disposition somewhat incompatible with spending long hours engaging with a machine on a one-to-one basis. The "dispositions of the mind and body" (Bourdieu, 1986, p. 47) which govern high-end computer-use - e.g. 'solitary individualism' vs 'sociable communitarianism' - are not necessarily innate to particular genders or social groups but do - at present - show correlations with a the studious middle-class type of masculinity often associated with the term 'geek'. This is not a particularly revolutionary reading of computing and 'geek' masculinity, being as it largely echoes Turkle's (1986, 2005) reading of computers and gendered psychologies from the mid-1980s. However, it is important to consider that such dispositions such as the self-tutoring computer geek are not fixed to specific groups but are likely to be the product of early socialization, meaning that - as already argued in section 6.2.1 -

any interventions to diversify the throughput of students in computing needs to place a greater emphasis on early years education.

6.5 Concluding Observations

Much has been made of the connections between masculinity, digital gameplay and young people's interest and aspirations toward careers in computing. This thesis has contributed to and enriched the existing body of work in this area by providing empirical examples of how, why and when players become 'enculturated' into technologically-oriented careers of leisure and work, and more importantly – to understand why such a process does not seem to occur for a much larger proportion of young people who play games. Much research in this area has tended to misrepresent or oversimplify the extent of gaming's role in technological enculturation by treating masculinity, technology and gaming as linked in a stable, monolithic way. By collecting and analysing biographical accounts from a purposive sample of predominantly male IT workers and students, I have been able to illustrate the ways in which a rather more specific type of masculinity prevails in this cultural area.

Despite being associated with a narrow focus on the individual, biographical analysis can serve to demystify broad-ranging assumptions around identity and enculturation. Connections which may seem obvious and widespread from one perspective are revealed to be based upon a priori assumptions which hinder a full examination of technoculture as it relates to intersections of gender, class, generation, nationality, and so on. It is only by comparing the accounts of seemingly similar individuals that we are able to see the fine, granular differences upon which (in/ex)clusion in computing classrooms and workplaces seem to rest. It may be the case that curriculum changes in the UK will do something to undermine the advantages currently enjoyed by those who grow up in homes where hobbyist computing is affordable and even encouraged.

Through the collection and analysis of biographies - individual narratives of lives, passions and careers - I have been able to identify salient connections between the home, school and adult world of work, and to contextualize these alongside popular discourses about work and play. The cultural homogeneity of the computing field can be understood as stemming from a number of interrelated factors. The marketing of games and hobbyist computing predominantly to boys in the 1980s, and the abandonment of computing in favour of more general ICT curriculum in the UK during the 1990s, are key contributory factors toward an IT industry which draws on a pool of self-taught hobbyists as an important source of skilled labour.

The fact that PC-gaming offers more learning opportunities cannot be divorced from demographic differences in terms of which young people enjoy access to which machines and the ways in which they are encouraged to interact with them (PC ownership alone does not a 'tinkerer' make!). Over the past decade or so, the games industry has also striven to make games and consoles which are more widely accessible and enable more social play, which means that young people who learn about software or hardware through gaming tend to be concentrated in an exclusive niche of PC gamers.

Identities like 'techy' or 'computer geek' – and the gender identities associated with these - rise from a complex interaction of factors. These factors include the production and marketing of hardware and software; educational norms; informal learning ecologies surrounding game-related activities such as networked-gaming, hobbyist game development and game modding; and also the role of the family in support, mentorship and the allocation of material resources. As a result, it is important to consider that the exclusion of girls from hobbyist computing is not necessarily a product of games themselves, nor entirely the boys who

more openly gravitate toward gaming as a preferred activity. Rather, I have illustrated how boys who learn technical skills through and alongside their gaming are a minority, many of whom have received some kind of support or encouragement to do so from predominantly male role-models.

I am hesitant to suggest that there is some 'right' way of learning about technology which can be applied universally; snapped up out of particular households and re-routed into schools and colleges. This is often the danger with work in education following Bourdieu - we set out to highlight how a privileged section of society gets a head start, and although it is always implied that this kind of social imbalance is wrong, the temptation for policy makers is to use this knowledge simply as a way to determine the 'correct' ways to teach or parent. Low enrolment numbers on computing courses do speak to some disparity between how young people are using computers every day and how computing is taught about in school, and this needs to be addressed. Perhaps shifts away from ICT and towards programming-focussed computing will help, particularly if young people are given more opportunities to program much earlier. This may do something to level the playing field for those who do not enjoy the same resources and degree of support at home. It will be up to future researchers in education and culture to remain constantly mindful of the messy overlaps between formal and informal learning and how they come to configure cultural spaces.

Games Cited[52]

A&F Software (1983) Chucky Egg [BBC Micro, ZX Spectrum, Dragon 32, Dragon 64, Acorn Electron, Commodore 64, MSX, Tatung Einstein, Amstrad CPC, Atari 8-bit machines, Atari ST, Commodore Amiga, IBC PC, mobile] A&F Software, Pick and Choose

Bethesda Game Studios (2011) The Elder Scrolls V: Skyrim [Windows, PlayStation 3, Xbox 360] Worldwide: Bethesda Softworks

Blizzard Entertainment (2002) Warcraft III: Reign of Chaos. [Windows, Mac OS, Mac OS X] EU: Sierra Entertainment

Blizzard Entertainment (2005-) World of Warcraft [Windows, Mac OS X] EU: Blizzard Entertainment

Blizzard Entertainment (2010) Starcraft II: Wings of Liberty [Windows, Mac OS X] EU: Blizzard Entertainment

Blizzard Entertainment (2014) Hearthstone: Heroes of Warcraft. [Windows, Mac OS X, iOS, Android] EU: Blizzard Entertainment

Bungie (2007) Halo 3 [Xbox 360; Xbox One] EU: Microsoft Game Studios

Capcom (1987) Mega Man [Nintendo Entertainment System, PlayStation, Android, PlayStation Portable] EU: Capcom

CD Projekt RED (2007) The Witcher [Windows] EU: CD Prokelt RED, Atari

Criterion Games et al. (2012) Need for Speed: Most Wanted [Windows, PlayStation 3, PlayStation Vita, Xbox 360, iOS, Android, Fire OS, Wii U] EU: Electronic Arts

David Braben and Ian Bell (1984) Elite [BBC Micro, Acorn Electron, Apple II, Amstrad CPC, Commodore 64, ZX Spectrum, MSX, Tatung Einstein, IBM PC, Acorn Archimedes, Amiga, Atari ST, Nintendo Entertainment System] Acornsoft, Firebird, Imagineer

Daybreak Game Company (2011) DC Universe Online [Windows, PlayStation 3, PlayStation 4] EU: Daybreak Game Company

Daybreak Game Company (2012) PlanetSide 2 [Windows, PlayStation 4] EU: Daybreak Game Company

[52] Efforts have been made to include all relevant information about games cited. The format used follows the convention; Developer(s) (initial release year) Game Time [platform(s)] Publisher(s). Although platforms are often omitted from academic lists of cited games or "ludographies", they are used here due to the thesis' emphasis on a platform studies approach (see 1.2.3). Dates given indicate the initial release date of a game in the EU region, and releases on subsequent platforms may have occurred later. See specific in-text citations for contextual information such as which platform the game was being played on by the participants who mentioned it. Games without a physical release (e.g. those such as Braid which were released worldwide via digital platforms) appear without a location of cited release.

EA Canada (2012) FIFA 13 [Windows, Xbox 360, PlayStation 2, PlayStation 3, PlayStation Portable, PlayStation Vita, Wii, Wii U, Nintendo 3DS, iOS, Windows Phone 8, Java ME] EU: Electronic Arts

id Software (1999) Quake III Arena [Windows, Xbox 360, Mac OS X] EU: Activision.

Jeremy Smith (1986) Thrust [BBC Micro, Acorn Electron, Commodore 64, ZX Spectrum, Amstrad CPC, Atari 8-bit machines, Commodore 16, Vectrex, Atari 2600, Atari ST] Superior Software, Firebird

Matthew Smith (1983) Manic Miner [ZX Spectrum, Amiga, Amstrad CPC, BBC Micro, Commodore 16, Commodore 64, DOS, Dragon 32, Dragon 64, Game Boy Advance, Microsoft Windows, Mobile phones] Bug-Byte et al.

Media Molecule (2008) LittleBigPlanet [PlayStation 3] EU: Sony Computer Entertainment Europe

Micro Power (1986) Imogen [BBC Micro, Acorn Electron] Micro Power, Superior Software

Nintendo EAD Group No. 4 (2015) Super Mario Maker [Wii U] EU: Nintendo

Neversoft et al. (1999) *Tony Hawk's Pro Skater* [PlayStation, Nintendo 64, Game Boy Color, Dreamcast, N-Game, Xbox] EU: Activision et al.

Number None, Inc. and Hothead Games (2008) Braid [Xbox 360, Windows, Mac OS, Linux, PlayStation 3] Microsoft Game Studios and Number None, Inc.

Richard Garriot, Origin Systems (1986) Ultima [Apple II; Atari 8-bit, Commodore 64, DOS, FM Towns, MSX2, NEC PC-8801, NEC PC-9801, Sharp X1, Apple IIGS] Various publishers

Riot Games (2009) League of Legends [Windows, Mac OS X] EU: Riot Games

Rockstar North (2004) Grand Theft Auto: San Andreas [PlayStation 2, Windows, Xbox, Xbox 360, OS X, PlayStation 3, iOS, Android, Windows Phone, Fire OS] EU: Rockstar Games

Rockstar North (2013) Grand Theft Auto V [Windows, PlayStation 3, PlayStation 4, Xbox 360, Xbox One] EU: Rockstar Games

Sirius Software (1983) Repton [Apple II, Atari 8-bit machines, Commodore 64] Sirius Software

Treyarch (2010) Call of Duty: Black Ops [Xbox 360, PlayStation 3, Windows, Wii, Nintendo DS, OS X] EU: Activision

Turtle Rock Studios (2008) Left4Dead [Windows, Xbox 360, Mac OS X] EU: Valve Corporation

Ubisoft Montreal et al. (2012) *Assassin's Creed III* [PlayStation 3, Xbox 360, Wii U, Microsoft Windows] EU: Ubisoft

Valve Corporation (1998) Half-Life [Windows, PlayStation 2, Mac OS X, Linux] EU: Sierra Entertainment, Valve Corporation

Valve Corporation (2013) DOTA2 [Windows, Mac OS X, Linux] EU: Valve Corporation

Glossary of Technical Terms and Software

BASIC – a language often pre-loaded ontocomputers, designed around ease-of-use due to similarity to natural English. BASIC is an acronym of “Beginner’s All-purpose Symbolic Instruction Code”. C family (C++/ C#) – a commonly-used family of programming languages. The game engine Source uses C++.

Cloning – the act of copying all or part of the design of an existing game, either as a form of commercial plagiarism, or as a learning activity for beginner game developers.

Construct 2 – a piece of game making software, originally released in 2011 by Scirra. Construct 2 allows the construction of 2-dimensional games without the use of a programming language.

Game engine – the underlying software of a game. Many games are built on pre-existing engines rather than bespoke engines developed for that specific game. A game engine can also include sub-engines for elements such as game physics or audio.

Playmaker for Unity –developed by Huton, Playmaker allows users of game-making program Unity to implement game logic through flow diagrams

JASS – a proprietary language used to implement advanced functions in Blizzard’s Warcraft III. Followed by GALAXY for Starcraft II. These languages are available to modders through the level-editors which come bundled with each game.

Javascript – a programming language used predominantly for web development.

GameMaker: Studio – a piece of game making software developed by YoYo games and first released in 1999. GameMaker: Studio allows the construction of 2-dimensional games without the use of a programming language.

GPU – a Graphics Processing Unit is an internal component of computers which deals with the production of (usually 3-dimensional) high-end graphics. Whereas GPUs are an in-built feature of games consoles, they are often an additional component for personal computers.

Logo – an educational programming language originally introduced in 1967. Most commonly remembered as a program where users drew lines using a ‘turtle’ avatar by inputting simple programming commands as one would to control a robot.

Microcomputer – a term for home computers popular in the UK during the 1980s; often pre-loaded with BASIC.

MMO - acronym for Massively Multiplayer Online game (sometimes in the context of MMORPG; a multiplayer Role Playing Game such as World of Warcraft). MMOs are games in which large amounts of players participate simultaneously in a persistent gameworld.

MOBAs - acronym for Multiplayer Online Battle Arena - a style of game popular from the first decade of the 2000s onwards, in which teams of players compete against each other for strategic control of a map, usually divided up into 'lanes' defended by computer-controlled static towers and moving military units. MOBAs are largely associated with the PC platform.

Mod – shorthand for ‘modification’; can refer to the addition or alteration of content to game software (such as levels, characters, vehicles etc.) or the physical modification of computer hardware.

QBasic – a later version of the BASIC language associated with DOS and Windows computers of the 1990s.

Raspberry Pi – a series of small personal computers introduced by a Cambridge-based company in 2012, meant to encourage young people to learn computing rather than be ‘locked in’ to graphical operating systems such as Microsoft Windows. Costing as little as £20, there is some interest in using them as part of the new computing curriculum in UK schools (The Guardian, 2012; The Guardian, 2015)

RPG Maker – a series of game-making software dating back to 1992, currently developed by Japanese company Enterbrain. RPG Maker specialises in making Japanese-style role-playing games and some community members are able to enhance their projects using scripts written in the Ruby language.

RTS - Real Time Strategy games are a genre where players view a battlefield from above and issue orders to troops and buildings in real-time (as opposed to turn-based strategy). Although there have been some successful RTS games developed specifically for consoles - this is a genre associated primarily with the PC platform.

Ruby – a programming language. Also used to add advanced scripts to RPG Maker games.

Scratch – an educational programming language developed at MIT and officially released first in 2005. Scratch is used to make small games and animations using flow-chart like logic; teaching children some of the basics of how computer programming works without the need for a specific language.

Source – the Source engine is a 3-dimensional game engine developed by Valve Corporation in 2004 and used in the creation of many commercial and hobbyist games. Source games are programmed using C++.

Stencyl - a piece of game making software, originally released in 2011 by Stencyl, LLC. Like Construct C, it allows the construction of 2-dimensional games without the use of a programming language.

UDK – Unreal Development Kit, initially released in 2009 by Epic Games is another piece of game-creation software, focussed on 3-dimensional games and using C++.

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